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VOL. 6 JANUARY–JUNE, 1958 No. 1

THE PROPAGATION OF THE GREY MULLET IN NORTHERN LUZON BRACKISH-WATER FISHPONDS

By G. J. BLANCO and PASCUAL A. ACOSTA
Of the Bureau of Fisheries, Quezon City

ONE TEXT FIGURE

The grey mullet, *Mugil cephalus* Linnæus, is the most economically important of the twenty species of mullets found in Philippine waters. It is almost world-wide in distribution, being recorded in New Zealand, Tasmania and Australia through the Malay Archipelago, the Philippines, Ceylon, the Indo-Pakistan subcontinent, East and South Africa, the Red Sea, the Mediterranean, the Atlantic and Pacific coasts of the United States, and the West Indies.

In the English speaking countries, the grey mullet young are called *Querimana.* In various Philippine dialects, the grey mullet is called *aligasin, banak, lumilitog* (Tagalog); *banak, balanak, guisaa, pili* (Visayan); *lapez, pasga, purong* (middle-size), *risec* (young), (Ilocano); *aguas, balanak, sarana* (Bicol); and *banak* (Tao Sug and Samal).

Description.—The grey mullet has an elongate body with two separate dorsal fins the first dorsal with four sharp spines. Yellowish ciliae-like teeth appear on the free border of the upper and lower lips. The eyes are provided with developed gelatinous eyelids anterior and posterior of the pupils. A distinct lateral line is wanting, but there are such several lines present formed by the connections of chromaophores of the longitudinal parallel scales of the upper sides of the body. From the middle of the gill opening to the fine scales of the anterior base of the caudal, there are 37 to 40 scales. The origin of the first dorsal is opposite the 23rd to the 25th scale of the mid-lateral scales. The anterior of the anal fin starts ahead

with reference to the anterior origin of the second dorsal fin. The caudal fin is deeply emarginate, its upper lobe is longer than the lower lobe. Short axilliary scales are present above the pectoral and pelvic fins. The natural color of the body is grayish above and silvery below, with a dark line along each row of scales in the upper half of the body. The second dorsal, anal, caudal and pelvic fins have dusky margins. The pectorals have the outer third blackish and have a narrow whitish margin and a dark cross band at the base.

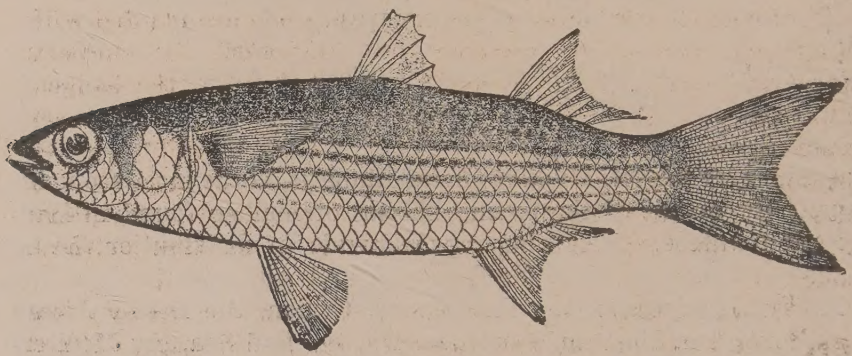

FIG. 1. The grey mullet, *Mugil cephalus* Linnæus. Illustrated by Pablo Bravo.

Habits and habitat.—The grey mullet is essentially a salt-water fish but it ascends river systems and brackish-water areas. It will thrive and grow rapidly in confined fresh and brackish waters but will not breed therein. The banak is easily acclimatized to live in fresh-water ponds. It is a hardy fish and it can be transported in suitable containers.

The adult mullet is a bottom and surface feeder. It lives on algal growth on substrata and along margins of fresh-water units. The food thus consists of considerable quantities of decayed organic matter, but because the fish also devours food at the bottom, considerable quantities of sand are often mixed with its food. The young mullet feeds on plankton with algæ from the surface.

Grey mullets breed in the sea throughout the year but the *Mugil cephalus* spawns during the dry season. This coincides with the spawning season of the bangos. In Chanos fry grounds the young of the species are collected with other larval marine species of fish caught with the bangos fry. Mullet fry abound in shallow coastal waters estuaries and mouth of rivers during the bangos fry season (April–July.)

Culture in other countries.—In Japan young *Mugil cephalus* about 3 to 6 centimeters in length which swarm around the estuaries of rivers from March to April are caught and then transferred to rearing ponds of brackish water or salt fields. The rate of stocking is one to three individuals per square meter of area. The fish grow to commercial size, weighing about 200 grams by the end of October or November. Japanese fish culturists allow the mullets to grow with carp or eels in the same rearing pond, sharing such artificial fish feed as rice-bran and flour.

In Hongkong 200 acres of brackish fishponds are planted with *Mugil cephalus* as the principal fish cultivated. In southern Formosa *Mugil cephalus* is commonly cultivated as the bangos.

In southern Celebes 50,000 acres of tambaks have not yet reached the degree of perfections as those in Java. Big acres of tidal marshes and sandy coastal flats have been embanked although devoid of subdivisions into compartments. Mugilidæ and Centropomidæ have been reared for a long time in these ponds.

In Hawaii coastal lakes are closed off from the sea by dikes and sluice gates and as such are operated as fishponds. Mixed species are impounded and *Mugil cephalus* is one of the most commonly reared.

Hora (1953) states that in brackish-water farms in Cochin (India) *Mugil cephalus* reportedly attain a size of 45 to 48.3 centimeters within a year. This also holds true for mullets grown in fresh-water ponds. Under favorable conditions in this region this quick growing fish can easily yield a production of 1,100 kilograms per hectare.

Culture and propagation in northern Luzon.—Preliminary experiments on the actual cultivation of the grey mullet *Mugil cephalus* with bangos, *Chanos chanos* Forskål, were reported by the junior author in June, 1953. A rearing pond of the demonstration fish farm at Pata, Claveria, Cagayan, was stocked with an equal number of grey mullets and bangos. The rate of growth of the mullets was observed to be at pace with the rapid growth of the bangos.

Another grey mullet that was grown successfully at the brackish-water demonstration fish farm is the *lurluran* (*Liza macrolepis*). The adult measures about 30 centimeters on the average. The fish differs from the *Mugil* species by the absence of the adipose eyelid and its fusiform shape. The feeding

habits and habitat are similar to that of any species of mullets of the genus *Mugil.*

In northwestern Luzon there are small brackish-water enclosures of about one fourth hectare area usually referred to as *pupukan,* fishponds with wooden or bamboo screen gates. A mixture of transient or migratory species such as *kitang* (*Scatophagus argus*) tarpon (*Megalops cyprinoides*), *Kurapo* (*Ephinephalus* sp.), *malaga* (*Teuthis* sp.), *lapes* (*Mugil cephalus*), and *lurluran* (*Liza macrolepis*) is allowed to enter the enclosure by opening the gate of the pupukan during the incoming high tide and closing it when the tides subside. Such fishes usually depend on the natural fish food available in the enclosures. The growth of algal food in these types of fishponds is sometimes faulty on account of the semisandy conditions of these ponds. However, the main source of the food for these mixed species of fish impounded is the estuarine plankton that enters the pond when water is being allowed. Supplementary feeds for the grey mullet are boiled camote and rice bran (darak) and corn meal. When such feeds are given the grey mullets they will grow fast.

The mixed species are allowed to grow for a duration of six to eight months before the harvest is made. This type of fish cultivation is general practice in northwestern Luzon and in some of the small islands of the Visayas. Like the fresh-water backyard fish farms this kind of subsistence fishing does not involve so much operational expenses.

Adams et al. (1931) first reported the possibility of raising the banak with bañgos in brackish-water fishponds, but this had never been actually done in the government fishponds. Private pupukan owners in northwestern Luzon had been practicing the mixed culture of fishes in their ponds for a number of years but were not aware of the fact that they were cultivating the grey mullet. There was no thorough identification of mullets propagated in ponds until recently, when the senior author examined the mullet specimens from the demonstration farm in Pata, Claveria.

We have enormous sources of mullet fry in our coastal and estuarine waters. It is just a matter of selecting the *Mugil cephalus* fingerlings and allowing them to enter the pupukan, to grow them with care until they are ready for harvest. A great number of pupukan owners should by all means continue to propagate the grey mullet as a superior source of fish protein as they do in Japan, Formosa and India.

BIBLIOGRAPHY

ADAMS, W., H. R. MONTALBAN and C. MARTIN.

1931. Cultivation of bangos in the Philippines. Phil. Jour. Sci. (Manila) 47: 1–38.

ARRIOLA, F. B.

1941. Notes on brackish-water fish farming in Luzon. Phil. Jour. Sci. (Manila) 76: 105–119.

BLANCO, G. J.

1950. The juvenile of some marine species of fish of northwestern Luzon, Philippines. Dept. Agri. Nat. Res. Tech. Bull. 20: 1–20.

BLANCO, G. J., and HERACLIO MONTALBAN.

1934. A bibliography of Philippine fishes and fisheries. Phil. Jour. Sci. (Manila), 54: 393–482.

BROMHALL, J. D.

1954. A note on the reproduction of the grey mullet, *Mugil cephalus* Linnæus. Hongkong University Fish. Jour. No. 1 (December, 1954) 19–34.

ROXAS, H. A., and CLARO MARTIN.

1937. A check-list of the fishes recorded from the Philippines. Dept. Agri. Comm. Tech. Bull. No. 6: 1–314.

ROXAS, H. A., and S. B. RASALAN.

1936. The mullet fishery of Naujan, Mindoro: Its effect on the ratio of the spawning mullet, *Mugil dussumieri Cuvier* and *Valenciennes*. Phil. Jour. Sci. (Manila) 59: 259–273.

SCHUSTER, W. H.

1952. Fish culture in brackish-water ponds in Java. Indo-Pacific Fisheries Council, Sp. Pub. No. 1.

ILLUSTRATION

TEXT FIGURE

FIG. 1. The grey mullet, *Mugil cephalus* Linnæus. 7

KAPIS FARMING AT THE TIDAL FLATS OF BACOOR BAY, LUZON

By GUILLERMO J. BLANCO
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TWO PLATES

The pearl oyster, *Placuna placenta,* is known locally in the Philippines as *kapis* (Tagalog), *kulintipay* (Ilocano) and *talampirong* (Visayan). The shell, due to its opacity and durability, has been commercially utilized in the manufacture of window sash. Placuna shells are also good sources of materials for the manufacture of lamp shades, picture and calendar frames, panel partitions, fruit and cake dishes, lanterns, trays, place cards and other novelties which are popular tourist attractions in the Philippines. Kapis meat is prepared into appetizing dishes such as kapis adobo, omelet, chowder, and other preparations.

SOURCES AND DISTRIBUTION

Window pane shell beds are located in many localities in the Philippines, particularly along eastern Manila Bay; Capiz, Iloilo, Panglao and Talibon, Bohol; Valladolid, Occidental Negros; Capiz, Iloilo; Samal, Bataan; and Sual and Labrador, Pangasinan.

Kapis are usually found in littoral zones and in waters 100 meters deep, but thrive best in the sand and mud bottom of shallow seas, coves and estuaries. In Bacoor Bay, Cavite, where the extensive, low tide flats of sandy, bluish to grayish bottom are favorable for its propagation, the window-pane shell is being cultivated simultaneously with the oyster.

BIOLOGY

The adult kapis is sedentary, free, unattached and lies on its flat right valve. Sometimes it is thickly covered with blue mud and debris. Like other bivalves, it breathes and feeds simultaneously, with the left valve raised slightly higher than the right valve.

The kapis shell is thin, flat, and with a rounded or oblong, outline. The left valve is moderately convex and the right valve is flat. The average short diameter of large shells measured along the line bisecting the angle formed by the teeth

is 12 to 14 centimeters. The entire shell and its meat content is about one centimeter thick.

Placuna has separate sexes, the eggs and sperm are cast and fertilization is external. The mature ova are globular to oblong, similar to the shape of the shell, and the spermatozoa also have a globular head and a long tail, 10 to 15 times the head length. The larvæ are free floating and begin their sedentary life as soon as the shell has developed.

In Bacoor Bay the window-pane pearl oyster spawns from October, March to December. The young attains a diameter of from 55 to 77 millimeters at the end of its first year, about 133 millimeters at the end of its second year, and matures in its third year.

Its food consists of minute plant and animal complex such as diatoms, dinoflagellates, tintinids, larval copepods, cyclopes and copepods and decaying detritus associated with blue mud.

CULTIVATION

The farmer does not need a big capital to invest in operating a kapis farm. Kapis farming is a side-line industry which does not occupy so many hours of work a day, so that one used to the sea can invest as little as 200 to 500 pesos to start a one-fourth hectare to one-half hectare kapis farm for buying essential equipment and materials.

The equipment needed for kapis farming are: one banca, two empty oil drums cut on top sidewise for soaking and cleaning shells, five small bolos, five bamboo brushes and several bamboo crating baskets. A small working shed house should also be built near the farmer's house for hired shuckers and cleaners of kapis shells and for storage of cleaned shells.

Important pointers to be considered in the selection of a suitable site for kapis cultivation are: (1) the kapis farm must be located in a protected bay, lagoon or cove having a bottom of blue mud and sand; (2) the area so selected must be extensive mudflats free from industrial pollutants, seaweeds or stones, a level area which is accomplished by raking the tidal flat evenly; (3) the farm must be fenced with bamboo (puno) and barbed wire, to enclose the area and to prevent trespassing by sailboats and individual fishermen; and (4) the kapis farm must be near kapis seedling grounds to facilitate the gathering, buying and transplanting of a large number of kapis seeds.

GATHERING AND TRANSPLANTING

To stock the private kapis *pabiayan* with kapis, it is necessary that kapis seeds be gathered from nearby places at Cañacao, Parañaque and Paombong, Rizal Province and Samal, Bataan Province when the seeds appear in November and December. Kapis seedlings are usually 25 to 40 millimeters long when gathered along the sandy shores of Manila Bay. Boatloads of kapis seeds are gathered and sold to kapis farmers at Binakayan, Kawit, Cavite, at the rate of 2 pesos to 2.50 pesos per 10,000 pieces.

On January 28, 1947, at the sandy beach and lagoons of Parañaque, Rizal, there were from 80 to 100 kapis seedlings to the square foot of the sandy exposed wet beach, and from 460 to 450 kapis seedlings to a square meter in the shallow lagoons. The seedlings were from 25 millimeters to 40 millimeters in diameter. They appeared in shoals one on top of the other and were covered with sand. The absence of food for the proper growth of the kapis accounted for the mortality of the kapis.

From November to December, 1949 and February to April, 1951, there were gathered kapis seedlings by the boatloads by individual fishermen at Navotas beach, Rizal. The equipment used by these fishermen were small bancas and bamboo baskets. The procedure was usually to feel with the feet and gather kapis with the bare hands from the bottom of the bay and then transfer the catch in bancas. Kapis located in deeper water (1 to 2 fathoms) were gathered by diving. A kapis seed collector who usually gathers from 5,000 to 10,000 pieces from early morning to sunset usually earns an average of 5 pesos.

When seedlings are gathered so many miles away from the breeding farm they must be impounded in small brackish water enclosures until such time that a truck load of twenty to thirty *kaengs* are ready for transit.

As soon as the truck load of kapis seedlings arrives at the kapis farm, they are counted and placed in a banca, ready for transplanting.

The planter usually broadcasts the immature kapis sparsely, approximately 100 to 200 kapis seedlings to the square meter. A one-hectare kapis farm is usually planted with 1,000,000 pieces of kapis seedlings.

Kapis seeds must be evenly spread in the *pabiayan* such that no two kapis seeds are on top of one another. When the

kapis accumulate in a certain area or areas, on the farm, due to undertows and wave action during high tides, they must be regathered in a banca and then re-spread evenly. Dead kapis must be removed from the kapis beds. The process must be repeated once in two weeks.

The kapis seeds will grow fast in a tidal zone of blue mud. When planted in October or November, they may be harvested in April or June of the following year. After six to eight months, kapis reach an average size of 144 millimeters in diameter and as such they are ready for harvest.

In the tropics, bivalves like kapis and oysters that are grown artificially in brackish waters have a faster rate of growth than those of the temperate regions. Sedentary animals grow fast within six to twelve months, because of the presence of favorable nutrients and abundance of available plankton food.

Studies on the rate of growth of placuna in Ceylon revealed that kapis attain the marketable size in five to eighteen years.

FACTORS AFFECTING THE CULTURE OF KAPIS

The window-pane shell in its natural habitat is usually affected by some unfavorable conditions such as occasional floods during the rainy months of June, July, August and September resulting in the mortality due to suffocation of a considerable number of the bivalves because of the deposition of mud and sand on the natural beds. During the drier months when the kapis beds are exposed at low tides dead shells are often noticed. This is a result of the covering of the shells partly or wholly with the brackish sponge.

Oyster drills sometimes attack the shells of the kapis by their radula the same way they attack the oyster.

Parasites usually found inside the mantle of the window-pane shells during shucking are gravid pea crabs and a number of worms which are not usually very harmful commensals.

A kapis *pabiayan* must be guarded every now and then from pouchers who make a habit of gathering kapis not for their shells but for kapis meat.

Under natural conditions there are not enough breeders to populate the area; hence, the not so steady appearance of kapis seedlings after every three years at Bacoor Bay. The reason for the early harvest of kapis is the continuous demand for kapis shells that are thin and transparent for the shellcraft industries. Two to three-year old kapis are thick and not very transparent, and are not needed so much in the industry.

PROCESSING AND MARKETING

Kapis are usually gathered and processed for their shells and for the delicious meat content after six to twelve months of rearing in the *pabiayan*. Shucked kapis meat usually sell as high as one centavo a piece or one peso per 100 pieces.

The shells are sorted after the meat has been shucked. The flat right side valves (*landay*) are piled in cones one meter in diameter and one meter high. The same is done with the left valves (*locon*) which are also piled in separate mounds.

In cleaning the kapis shells are soaked overnight in a tubful of water and then scrubbed piece by piece on each side with a brush in order to remove dirt and discoloration to produce the desired luster. The shells when cleaned and dried are graded according to their size and quality, as first, second, third and fourth class. The locon is usually graded as fourth class.

Cleaned kapis shells are usually packed in bamboo baskets of 10,000 pieces capacity. First class shells sell as high as 90 pesos per 10,000; second class, 70 pesos per 10,000; third class, 60 pesos per 10,000 and fourth class, 45 pesos per 10,000 pieces.

The demand for kapis shells in window sash factories is enormous and the value of kapis shells needed to supply such factories in Taytay, Parañaque and Las Piñas in Rizal Province; Kawit in Cavite Province; and Manila and other localities in the Philippines, would run into millions of pesos.

From 1951 to 1954 inclusive, there was exported a total of 6,084 pieces of manufactured articles made from kapis shells, such as lamp-shades, lanterns, cigarette boxes, calendar and picture frames, valued at 31,158.88 pesos as shown in the following table:

Year	Quantity exported (Pieces)	Value *Pesos*
1951	1,516	1,892.88
1952	445	2,624.60
1953	2,123	7,881.40
1954	2,000	18,760.00
Total	6,084	31,158.88

REFERENCES

BLANCO, G. J.

1949. Aquatic resources of the Philippines. Reprinted from our Food Production Campaign, Dept. of Agri. and Nat. Res. pp. 3–11.

HARDENBERG, J. D. F.

1950. Estuarine problems in South East Asia. Indo-Pacific Fisheries Council Proceedings, 2nd Meeting, 17th–28th April 1950, Sections II and III. pp. 175–180.

HORNEL, J.

1905. Report on the placuna placenta pearl fishery of Lake Tampalakaman. Ceylon Sessional Papers 14.

1906. Report on the placuna placenta pearl fishery of Lake Tampalakaman. Report Ceylon Marine Biological Laboratory No. 2:42–53.

LE MARE D. W.

1951. Applications of the principles of fish culture to estuarine conditions in Singapore. Indo-Pacific Fisheries Council Proceedings 2nd Meeting, 17th–28th April 1950. Sections II and III. pp. 180–183.

MOSES, S. T.

1939. The recent placuna pearl fishery and some notes on the window-pane oyster. Bombay Nat. Hist. Jour. 41 No. 1: 119–122.

PANNIKKAR, N. K.

1951. Physiological aspects of adaptation to estuarine conditions. Indo-Pacific Fisheries Council Proceedings, 2nd Meeting, 17th–28th April 1950. Sections II and III. pp. 168–175.

PEARSON J.

1912. Window-pane oysters in the Colombo Lake. Spol. Zeyl.

1912. Report on the window-pane oyster investigation. Spol. Zeyl. 223–242.

1913. Report on the window-pane oyster investigation. Spol. Zeyl. No. 32. 223–242.

ROCHFORD, D. J.

1951. Summary to date of hydrological work of the fisheries division, G.S.T.R.O. Indo-Pacific Fisheries Council Proceedings, 2nd Meeting, 17th–28th April 1950, Sections II and III. pp. 51–59.

STEPHENSON, W.

1951. Preliminary observations upon the release of phosphate from estuarine mud. Indo-Pacific Fisheries Council Proceedings. 2nd meeting, 17th–18th April 1950. Sections II and III. pp. 184–189.

ILLUSTRATIONS

PLATE 1

Shell crafts, lamp shades, screens, fruit basket, picture frames, and other items made from kapis shells.

PLATE 2

Placuna placenta shells. Left and right valves reduced ⅓ natural size.

PLATE 1.

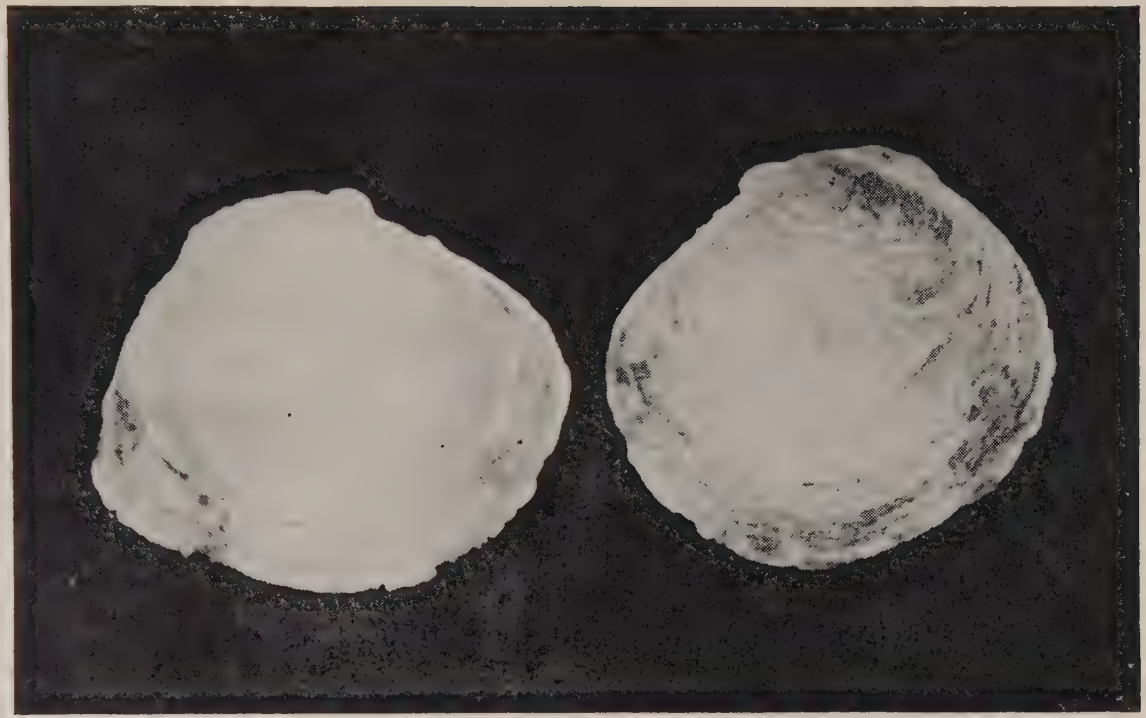

PLATE 2

THE AQUATIC PRODUCTS OF ZAMBOANGA, BASILAN AND THE SULU ARCHIPELAGO

By Jose S. Domantay
Of the Bureau of Fisheries, Quezon City

INTRODUCTION

The topographical conditions of South Zamboanga, Basilan Island and the Sulu Archipelago where there are approximately one hundred fifty fairly large islands and some two hundred islets and reefs lying between 4° and 8° north latitude, contribute to the abundance of varied marine commercial products. Nature has endowed this part of the Philippines with rich resources of the sea, both for food and for commerce, which constitute a very important source of livelihood for the inhabitants of the place. The majority of the natives (Badjaos, Samals and Tausugs) do not need to till the ground so much because they can make their living from the wealth of the sea. Many of these natives, especially the Samals and the Badjaos, do not construct permanent homes for they live mostly in fishing *vintas* [1] or in provisional shelters constructed in shoals or shallow flats along the coast. Vintas supported up over a meter high from the ground by provisional posts, or a group of vintas in shallow waters inside well protected coves are sufficiently seen around the many small islands of the place. Groups of Moro houses, both permanent or provisional in nature are common sights along the inshores of the entire southern Zamboanga and Sulu Archipelago. From the custom of these seafaring people living mostly in the sea, one can imagine the contentment they get from the vast wealth of the sea.

EDIBLE SEAWEEDS

There are twenty-one species of seaweeds of economic value so far reported from the Philippines but many more may be encountered around these places. Waters along the eastern side of Palawan and of the entire Sulu Archipelago are veritable forests of seaweeds. Way back in 1937 when the writer made a preliminary survey of the fauna of the Ulugan and St. Paul's Bays of eastern Palawan, veritable seaweed forests were ob-

[1] Vinta—a sharp-keeled dugout with outriggers on both sides usually propelled with the aid of a sail.

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served, composed mostly of the brown algæ, *Sargassum,* of different species. Most of the brown algae may not be very useful as food although they may be a good source of important chemicals like iodine, bromine, santonin, soda, chloride, sulphate and alginic acid. Together with some of the green algæ they are good sources of fertilizer and stock feed.

In the southern part of the Sulu Archipelago around the neighborhood of Sitankai are dense forests of green algæ mostly of the edible species. Several varieties of the species *Caulerpa recemosa* locally known as *lato* cover mostly the vast and extensive shoals around the place. In Zamboanga and in many market places of the Sulu Archipelago are frequently encountered several species and varieties of this edible green algæ. Species of *Gracilaria, Eucheuma, Halymenia, Hypnea, Laurencia* and other forms of red algæ are found almost everywhere in southern Zamboanga and Sulu waters. Species of *Gracilaria* and *Eucheuma* are sold under the local name of *agal-agal.* All these algæ constitute the most common edible seaweeds around the place.

COMMERCIAL SPONGES

No less than one hundred species of sponge are found in the Philippine waters. The great bulk of the Philippine sponges is found in the Zamboanga and Sulu waters. These belong to the Order Keratosa represented by few families, namely, *Leiodermatidæ, Spongidæ,* and *Spongelidæ.* From the collection of sponges taken, the writer has identified over a dozen species and varieties of the commercial forms.

Sponges taken from the water around Zamboanga and the Sulu Archipelago are of good quality. During the years 1916 to 1935 there were 21,168 kilograms of commercial sponges exported from the Philippines, valued at 146,882 pesos or an average of 1,058 kilograms valued at 7,344 pesos yearly. About 99 per cent of the products exported came from this region. During the past 15 years foreign trade on the aquatic product was very poor.

Among the commercial species and varieties taken from the Zamboanga and Sulu waters, the following deserve special mention:

Leiodermatium pfeifferæ (Carter) is the elephant ear sponge. There are two varieties of this species, the shallow-water and the deep-sea forms. The shallow-water or littoral form is

usually thinner and irregular in shape. It is not commercial unlike the deep-sea form which is thicker and of regular vase-shaped which is used in padding high quality horse saddle and for insulating helmets.

Spongelia fragilis var. *incrustans* Schulze, *S. fragilis* var. *tubulosa* Schulze, *S. fragilis* var. *ramosa Schulze, S. fragilis* var. *fasciculata* Wilson, *S. elastica* var. *massa* Schulze, and *S. elastica* var. *lobosa* Schulze are known in commerce as the sheepwool and honeycomb sponges. All the varieties enumerated above are found in the place. They are deep-sea sponges. Without regular sponging boats the above sponges cannot be properly exploited. Collections of the sponges used by the writer for study were made by the pearl divers of the former pearling boat "Thistle" upon request.

Euspongia officinalis var. *mollissim* Lendenfeld, *E. officinalis* var. *ceylonensis* Dendy, *E. irregularis* var. *villosa* Lendenfeld, *E. irregularis* var. *suriganensis* Wilson, and *E. irregularis* var. *jacksoniana* Lendenfeld are species and varieties of sponges known in commerce as the grass sponge. They are littoral form usually found in shallow rocky shoals or coral reefs. The extensive shoals around the neighborhood of Sitankai and those of the Ulugan and St. Paul's Bays of eastern Palawan are enormous fields of this grass sponge. One can exploit this form of sponges without the regular sponging boat. The concession system may be most applicable for this species of sponges.

The species *Phyllospongia foliascena* (Pallas), and *Phyllospongia aliena* Wilson ,are also littoral form like the grass sponges. They may not be important commercially. Like the shallow-water form of the *Leiodermatium pfeifferæ* (Carter) they can be used for padding saddles, cushions, and similar items.

COMMERCIAL CŒLENTERATES

Next to the sponges are the black corals of the species of *Cirripathes anguina* and *C. spiralis* apparently reported as *Antipathes ibis* and other varieties. All the said varieties are commercially important for jewelry and other novelties. The straight solid unbranched variety is the most highly valued although the hollow variety is also used for similar purpose. The spiral variety is also used for making bracelets and earrings. The basal part of the branched *Antipathes* species is also used for bigger kind of jewelries.

This marine product though not usually exported from the place is exclusively used locally by the black coral jewelers. The numerous varied fancy black coral jewelries and novelties made Zamboanga famous before the outbreak of the last world war which continued up to the present time. Tourists, both foreigners and Filipinos as well, who stop at the place never miss buying these souvenirs. Transient merchants used to buy them by the lots for business purposes.

Around the immediate vicinity of Zamboanga this marine product has been depleted to some extent although the extensive deeper coral reef regions of Zamboanga, Basilan and the Sulu Archipelago still offer a vast field for exploitation. Most of the deeper waters are still unexploited of this important marine product because of the difficulty of uprooting them from their attachment. An ordinary naked diver can bring one up only after two or three dives. In order to exploit the deeper seas for this product, one will have to use the regular sponging boat with the necessary diving apparatus.

The sea-anemone belonging to the same class and phylum as the black corals are used as food by the Moros. Practically, all kinds of sea-anemone from the smallest to the largest species are sold in the local markets of southern Zamboanga, Basilan and all over Sulu. The local name of the sea-anemone in the place is *tumbong-tumbong* and among the Moros, they are known as *loon,* and *kambang* according to the size and color.

COMMERCIAL ECHINODERMS

Beche-de-mer (*trepang*)

Beche-de-mer (*trepang*).—*Beche-de-mer,* or *trepang,* is made from the commercial sea-cucumbers or holothurians belonging to the Phylum Echinodermata. Sea cucumbers are marketed either fresh or in dried form as *beche-de-mer or trepang.* The smaller edible species which when dried, shrink a great deal and cannot command a good price are the ones usually sold fresh. At times the bigger species are also sold fresh. Among the small and medium-sized species of sea cucumbers sold fresh and used as food locally are the following: *Holothuria pardalis* Selenka, *H. pardalis* var. *cebuensis* Domantay, *H. curiosa* Ludwig, *H. curiosa* var. *philippinensis* Domantay, *H. maculata* Brandt, *H. gyrifer* (Selenka), *H. impatiens* (Forskal), *H. scabra* (Jaeger), *H. bivittata* Mitsukuri, *H. edulis* Lesson, *Actinopyga miliaris* (Quoy and Gaimard), and *A. serratidens* Pearson.

Sea cucumbers are usually dressed when sold at the local market. The internal organs are removed and the body is cut into small pieces soaked in fresh sea water to which has been added vinegar or lime to prevent decomposition. Other species sold in the round are disposed off immediately because they decompose so easily, giving a nasty appearance and foul odor. Sea cucumbers are known to the Moros as *bat* or *balat*. The different kinds are known as *bat tagokang, bat puti, bat doroan, bat bantonan,* and other names.

The other commercial species and varieties which are marketed in dried form under the trade name of *trepang* or *beche-de-mer* are the following:

Scientific name	Local name
Actinopyga echinites (Jaeger) *Actinopya maurtiana* (Quoy and Gaimard)	Oe Liow (Kamotihan).
Argiodia maculata (Brandt)	Bah Sims; Oh Sim; Gan Sim (Buki).
Holothuria argus (Jaeger)	Ang Tiow Sim.
Holothuria scabra (Jaeger)	Hea Sim (Patos).
Thelenota ananas (Jaeger)	Chea Sim (Makhangkahang or Sorosoro).
Stichopus chloronotus (Brandt)	Che Hong Che Sim (Cuatro esquina).
Stichopus japonicus Mitsukuri	Tah Deek Sim or Hong Che (Matinik).
Holothuria atra (Jaeger)	Thang Sim (Gamong).
Holothuria maculata (Brandt)	Thoot Sim (Puti).

The greater bulk of the dried products comes from Sitankai, Bongao and neighboring places where the Chinese *beche-de-mer* dealers cure them with other marine products that are gathered from the vast extensive shoals of the place. The numerous extensive coral reefs and shoals around Sitankai, Tumindao, Sibutu, Bongao, Tawi-Tawi and neighboring places are the most important fishing grounds of commercial sea-cucumbers. In Zamboanga and in Basilan they are usually fished out from the coral reefs and shoals around Basilan and Olutanga Islands and other neighboring places.

The sea-urchins.—The other echinoderms used as food by the Moros and some Christians alike are the sea-urchins locally known as *Salongo* and *tihi-tihi*. The external appearance of these globular echinoderms covered with numerous stiff spines

which are venomous in some species would not attract anybody from using them for food. But those who know their food value will not hesitate to pick them up and make use of their delicious gonads (reproductive organs). The gonads (ovary and testis) are loosely attached to the inner wall of the test so that when one breaks it and removes the digestive organs, the gonads can be easily scraped off and saved. These are the ones sold in the local market leaving the test right in the seashore. They are usually eaten fresh after adding little vinegar or lemon juice. Some people pour boiling water over the entire animal while others boil the entire animal before removing the gonads. The sea-urchins are known as *salongo* among the Christians and *tihi-tihi* among the Moros. The common sea-urchins with small and non-venomous spines used for food are the following species: *Salmacis sphaeroides* (Linnæus), *S. sphaeroides* var. *variegata* Mortensen, *Anthocidaris crassispina* A. Ag., *Toxopneustes pileolus* (Lamarck), *Tripneustes gratilla* (Linnæus), and *Pseudoboleta maculata* Troschel.

The sea-urchins with venomous spines, *Diadema setosa* (Leske), 2 *Centrechinus setosus,* and *Echinotrix calamaris* (Pallas), though with long sharp spines are also used for food like the others. One should be very careful in handling them to avoid pricking because of the pain imparted by the venomous spines. Generally all the sea-urchins are of economic value especially the bigger species with more bulky gonads. Majority of the sea-urchins reported from the Philippines by H. A. Roxas in 1928 are found in the Zamboanga and Sulu coral reefs and shoals.

Sea-stars or starfishes.—Another echinoderm of commercial value which are abundant in the Zamboanga and Sulu waters are the sea-stars or starfishes. When dried they are made into fertilizer. Just before the outbreak of the last world war in 1941 there was a big firm organized in Manila for the manufacture of fertilizer. A representative of the said firm was sent to Zamboanga to buy dried starfishes. Some Moros were hired to gather the newly exploited marine product. Even for a short time several tons of dried materials would have been shipped to Manila had it not been for some misunderstanding on the part of the agent who gathered them without seeking first the necessary permit from the Secretary of Agriculture and Natural Resources. After the war, apparently, the business was resumed and some people in Zamboanga collected and dried the starfishes for the Chinese dealers. With proper and scientific

preparation the starfishes can be made into fertilizer and starfish meal for poultry feed.

There are extensive places where the bigger species of starfishes, the *Oreaster nodosus* (Linnæus) *O. alveolatus* (Perrier), *Linckia laevigata* (Linnæus), *L. guildingii* Gray and different species and varieties of *Culcita, Nardoa, Pentaceropsis,* and other genera can be collected by the boatloads. One does not need to dive for them during low tide. The exploitation of this marine product will be for the good of our pearl oyster fisheries because the starfishes constitute the major enemies of the oysters in general. All the starfishes that were reported by the writer and H. A. Roxas in 1938 from Port Galera and adjacent waters are found in the Zamboanga and Sulu waters. Both small and large species of starfishes are of commercial value. The smaller ones are easier to prepare into either fertilizer or starfish-meal.

From the commercial point of view all the echinoderms composed of the brittle stars, sea-lilies, sea-urchins, heart urchins, sand dollars and all starfishes can be made into fertilizer. The brittle stars, sea lilies and sea urchins when dried will not require expensive presser to pulverize them, hence, they can be easily made into fertilizer.

The following starfishes are found all over the Zamboanga and Sulu waters mostly among coral reefs and in sandy and grassy shoals: *Archaster typicus* Muller and Troschel, *A. angulatus* Muller and Troschel, *Oreaster nodosus* (Linnæus), *O. alveolatus* (Perrier), *O. doederleini* Goto, *Pentaceropsis tyloderma* Fisher, *P. obtusatus* (Bory de Saint Vincent), *Culcita novæ-guineæ* Muller and Troschel, *Culcita novæ-guineæ* var. *plana* Goto, *C. novæ-guineæ* var. *typica* Goto, *C. novæ-guineæ* var. *acutispinosa* Goto, *Halityle regularis* Fisher, *Choriaster granulatus* Lutken, *Leiaster speciosus* von Martens, *Linckia laevigata* (Linnæus), *L. guildingii* Gray, *Nardoa variolatus* (Lamarck), *N. pauciforis* (von Martens), *N. tuberculata* (Muller and Troschel), *N. frianti* (Koehler), and *Echinaster luzonicus* (Gray).

COMMERCIAL CRUSTACEANS

Out of the 507 species of known crustacean decapods of the Philippines there are around two hundred species reported from the Zamboanga and Sulu waters and adjacent places. Many of these crustaceans though edible are not usually com-

mercialized because of their size. The following constitute the important commercial species:

Scientific name	Local name
Penaeus indicus Milne-Edwards	Lokon.
P. monodon Fabricius	Lokon.
P. affinis Milne-Edwards	Camaron or Pusayan.
P. canaliculatus	Camaron or Pasayan.
Palaemon sp.	Baling or alamang.
Panulirus penicillatus (Oliver)	Banagan (Kiyo-ot).
P. ornatus (Fabricius)	Banagan (Kiyo-ot).
P. versicolor (Latreille)	Banagan (Kiyo-ot).
Ranina dentata (Latreille)	Kukuratsa.
Scylla serrata (Forskal)	Cangriejo or alimañgo.
Neptunus pelagicus Linnæus	Kagansukay or kasag.
N. (*Achelous*) *granulatus* (Milne-Edwards)	Kagansukay or kasag.
Charybdis (*Goniosoma*) *crucifera* (Fabricius)	Dawat.
Squila (sea mantis) several species	Kamontaka or kamun.

Among the small species of crustaceans commercialized, the *Palaemon* sp. which may be represented by several species usually appear in big school during a certain part of the year, hence, usually fished out in large scale and salted into fish paste. They are known locally as *baling* or *alamang*. Like the *ipon* or *oyap, dilis, bolinao, pinatay* and the *lupog* or *tamban,* the *baling* constitute the principal materials for the fish paste industry of the place. These little crustaceans were at one time very abundant throughout the place. Many years ago, in Margosatubig the *baling bagoon* was as important as the *bolinao* and the *lupoy* but during the later years they almost disappeared apparently due to depletion. It is said that the absence of regulatory measures in catching this important marine product must have been the probable cause. At present most of the *baling-bagoon* or *alamang* come from the Sulu region. The most important Palaemon fishing grounds these days are around Tawi-Tawi near Bato-bato and several other places. Several thousand pesos are being derived from this industry annually.

The *Penæus* of several species are the common commercial species which abound in the Zamboanga and Sulu waters. They are locally known as *camaron, pasayan* and *lokon,* the last is of the big species. From the smaller species are made the dried product called *hebi* which is exported from the place. Most of these shrimps are caught from fishponds although a great number of them comes from rivers and creeks inside

mangrove swamps by small fishing nets. The major bulk of the catch is marketed fresh in the local market.

At times certain fresh water shrimps with one cheliped enlarged locally known as *takla* are caught by small fish corral known as *tankub* placed across the creek inside mangrove swamp. The *Panulirus,* spiny lobster, represented by three species and the *Squilla,* sea mantis, of several species are oftentimes sold at the local markets. The former is known locally among the Moros as *Kiyo-ot* and among the Christians, as *banagan,* and the latter as *Kamontaka* or *kamun.* They are fished by the Moro fishermen with gun spear known as *pana,* an arrow operated with an improvised gun serving as the bow.

The most common crabs sold locally are the *Scylla serrata* and the *Charybdis* (*Goniosoma*) *crucifera* which are known as *cangriejo* or *alimañgo* and *dawat* respectively. The former is usually considered a delicacy among the people, hence sold at a very much higher price than the other crab. Both species of crabs are usually caught inside fishponds and from the mangrove swamps by a small bamboo fish trap called *nasa.* The *nasa* has gilled openings at both ends so that once the crab gets inside, it cannot escape anymore. It is baited with dead fish or other organic material which can attract the crab from the outside. Another crab fishing gear used is the *bintol,* a small square piece of net supported by a bamboo framework set crossly at whose ends are attached the corners of the net and suspended at the middle by a rope. A dead fish as bait or other organic material is tied at the center of the net before it is submerged at the bottom of the stream. From time to time the *bintol* is hauled up and the catch is removed. This fishing gear is also used in catching the deeper sea crab, *Ranina dentata* known locally as the *kukuratsa.* This crab is oftentimes brought to the local market in big scale and is sold cheaper than the *Scylla serrata.* It is better in many respects. Its flesh tastes just as good if not better than *alimañgo* and with more meat. The *kukuratsa* is fished from deeper waters and not scavenger unlike the *alimañgo.* It is found throughout Zamboanga, Basilan and Sulu and apparently found in abundance only in these places.

COMMERCIAL SHELLS

Among the numerous molluscan shells of the Zamboanga and Sulu waters, the most important which constitutes the major

commercial marine products are the commercial shells listed below:

Scientific name	Common name
Pinctada maxima (Jameson)	Gold-lip pearl shell—*Concha blanca* or *tipay bas.*
Pinctada margaritifera (Linnæus)	Black lip—*Concha negra or tipay batu.*
Trochus niloticus Linnæus	Smooth top shell—*Trocas* or *lak.*
Trochus maximus Kock	Rough top shell—*Trocas* or *lak.*
Trochus noduliferus Lamarck	Female top shell—*Trocas "hirose"* or *"poteh".*
Turbo marmoratus Linnæus	Turban shell (Green snail) *Lagong* or *laong.*

The exportation of pearl shells (M.O.P.) from Jolo and Zamboanga for the year 1913 was 300,794 kilos valued at 349,498 pesos which is much more than the average yearly exportation from 1916 to 1935. The total exportation of the pearl shells (M.O.P.) from the years 1916 to 1935 amounted to 4,230,474 kilograms valued at 3,182,232 pesos or a yearly average of 211,524 kilograms at 159,112 pesos or an average cost of 75 centavos per kilogrm. The total exportation of the Trochus shells, the green snails or turban shells, etc. from the year 1916 to 1935 amounted to 5,957,616 kilograms, valued at 1,713,098 pesos, or an average of 297,881 kilograms at 85,655 pesos a year, or an average cost of 30 centavos per kilogram. Around 90 per cent of the pearl shells and 70 per cent of the Trochus and turban shells came from Zamboanga, Basilan and Sulu waters.

Year	M. O. P.	Value	Trochus	Value	Turban	Value
	Kilos	*Pesos*	*Kilos*	*Pesos*	*Kilos*	*Pesos*
1913	300,794	349,498.00	253,395	103,125.00	65,035	21,860.00
1933	20,697	8,060.00	1,726	1,117.00	3,261	866.00
1934	20,302.5	11,797.00	5,764	2,635.00	3,643	2,001.00
1946	245,660.5	294,792.00	473,167	236,583.00	20,579.5	10,289.00
1947	330,303	660,606.00	251,992	125,996.00	9,425	4,712.00
1948	260,534	260,534.00	283,724	113,489.60	4,734	1,183.50
1949	308,170	308,170.00	268,601	120,870.45	6,322	1,580.50

A comprehensive report and statistics of these commercial shells that were exported from Jolo and Zamboanga from the years 1935 to 1940 were prepared by the writer but the entire

records were lost during the last world war. The available records of 1913, 1933, 1934, 1946 to 1949 inclusive can give us an idea about the difference in volume of business in those years as seen in the table on page 26.

In 1914, the M.O.P. shells exported from the Sulu Archipelago were almost the same as those in the previous year. In 1926, there were around 3,700 piculs or 231,250 kilograms of gold-lip pearl shells alone, valued at 149,166 pesos exported from Jolo and in 1929, the export in pearl shells dropped to 108,917 pesos. The peak of the business was during the years 1917 to 1920 when there were no less than one hundred pearling boats operating around Zamboanga and Sulu with the price of the shells higher compared with that of the later years.

The conspicuous fall of the business in 1931 was due to the withdrawal of many of the Japanese pearling boats which exploited a new virgin pearling ground around the Pelew Islands which caused the corresponding fall in price of the shells. In 1937 when the writer first arrived at Zamboanga there were around eight pearling boats still in operation. In the later part of 1941 there were but only three boats left in operation. One of the pearling boats that retired from the business in 1939 was the P/B "Thistle" owned by Mr. James J. Wilson. This boat was forced to be laid off due to poor business as a result of the flooding of the world market with shells from the newly exploited pearling ground. Other pearling boats were either wrecked or damaged when tied up for some obvious reasons. The three remaining pearling boats quitted the pearling activities since the outbreak of the last world war. From the outbreak of the Pacific War in December 1941 to the liberation of Manila in 1945 pearling activities were stopped. This gave the pearling business a long time to recuperate. Pearling operation by naked divers resumed in the early part of 1946. The first pearling boat "Amelia" started operating in April 20, 1946. The second boat, "Joe Palooka" and the third, "Katipunan" began to operate in November 1946 and January 1947, respectively. In the early part of March 1947, the P/B "Pilgrim" followed. The M.O.P. shells collected and marketed in 1946 with the exception of those gathered by P/B "Amelia" in April-December 1946 and by P/B "Joe Palooka" in November-December 1946 were all gathered by naked divers from the shallow pearling beds. The increase in volume and in value during the succeeding years was due to the activities of licensed

pearling boats and the rise in price of the shell. This also shows that the long rest the pearling beds had during the war has greatly increased the number of M.O.P. shells tremendously. With the four pearling boats in operation which worked out the deeper pearling beds beyond the reach of the naked divers, the production for the year 1947 increased tremendously.

Trochus shells are gathered from shallower waters and do not need the use of special outfits like the pearling boats. Production of trochus shells in 1946 was almost twice as in 1913 and many times bigger than that in 1934. The following are the monthly local current prices of the commercial shells in 1946:

1946 Monthly Local Current Prices of Commercial Shells per kilo[2]

	M.O.P. Peso	Trochus Peso	Turban snail Peso
January			
February	0.60	0.35	3.35
March	0.60	0.35	0.35
April	0.60	0.40	0.38
May	0.70	0.40	0.35
June	0.70	0.40	0.35
July	0.75	0.40	0.35
August	0.80	0.40	0.35
September	0.90	0.40	0.35
October	0.90	0.35	0.35
November	1.10	0.30	0.30
December	1.20	0.30	0.30

The pearling beds in the Sulu Archipelago could not be fully worked out by the four pearling boats under operation because of the rampant piracy around the area. This caused pearling activities to be concentrated around Zamboanga, Basilan Island and the immediate neighborhood of Jolo.

The pearls.—The pearls though seldom obtained from the pearl oysters constitute a very important sideline industry of the pearl fisheries. If the owners of the pearling boats are lucky they might derive much income from the pearls alone than from the shells. In the early years when the pearl business was at its best and before the perfection of the cultured pearls by Mikimoto, Englishmen, Frenchmen and other foreigners frequented Jolo and Zamboanga to buy pearls. There were instances when pearls costing few hundred pesos locally were sold in Europe for many times their original price. It was

[2] The price of M.O.P. shells went up to 2.20 a kilo in April 1947.

reported that a certain Moro diver sold an 8-karat pearl to a Chinese in Jolo for 100 pesos which was in turn sold to another Chinese dealer for 800 pesos. This same pearl was sold for 3,500 pesos to a Frenchman who sold it in Europe for twice what it cost him. The true value of the said 8-karat rosy pearl, according to expert merchants, was no less than 6,000 pesos. In 1917 a certain Japanese pearler in P/B "Cleopatra" obtained a 24-karat pearl which was sold to the late Mr. Boon Liatt, a Chinese pearl merchant and shell dealer of Zamboanga for 18,600 pesos. In 1929, the total value of pearls was estimated at around 200,000 pesos, which was very much less than the estimates for the pearls exported in 1914 from the Sulu Archipelago amounting to 1,000,000 pesos. After 1930 the business in pearls was not so lucrative as in the previous years. The flooding of the London pearl market with many perfect round cultured pearls by Mikimoto which could not be easily differentiated from the natural pearls greatly affected the price of natural pearls.

COMMERCIAL MARINE TURTLES

There are three common species of marine turtles found in the Zamboanga and Sulu waters. The *Eretmochelys imbricata* (Pennant) is valuable because of its shell which is made into combs, etc. The *Chelonia mydas* and the *Caretta olivacea* (Eschscholtz) are partly commercial because of their meat and eggs used for food.

The principal turtle fisheries are found around the vicinities of Sibago, Lanhil and Sangboy Islands of Zamboanga, the San Miguel and Bancoran Islets and neighboring reefs of Sulu, and the Turtle Islands near the vicinity of Borneo. The latter group of islands which consists of seven islets was administered by the British North Borneo until they were turned over to the Philippines lately in 1947.

For the years 1916 to 1935 the Philippine export of tortoise shells was 26,646 kilograms, valued at 354,631 pesos with an average of 1,333 kilograms at 17,731.55 pesos yearly or at an average cost per kilogram of 13.30 pesos. The tortoise shells are classified into different grades. The thick shells of amber yellow color with natural artistic dark spottings in the form of bouquet are regarded the best quality and are sold from 100 pesos to 400 pesos a set of 13 scutes. Inferior grades are sold from 4 pesos to 20 pesos a kilo. Around 75 per cent of

this marine product comes from the place. Several thousands of pesos were derived annually from the turtle eggs gathered from the above mentioned turtle fishing grounds. Most of the eggs are commercialized by the Chinese in Jolo and in Borneo before the Turtle Islands were turned over to the Philippines. At present the turtle eggs in the Turtle Islands are administered by the local government and sold to the traveling merchants by the thousands.

From the statistical data compiled by the writer on the tortoise shells exported from Jolo to Zamboanga for the years 1936 to 1941 which was lost during the last world war, there was an apparent decrease of this marine product due possibly to depletion. Most of the turtle fishermen in Siasi and Bongao usually fish for the said marine product around the vicinity of Palawan. These turtle fishermen would not go that far if they could fish them around their home vicinities only. The apparent depletion of the *Eretmochelys imbricata* (Pennant) locally known as *sisikan* or *pawikan* is due to the reckless and extensive fishing of this particular species during the past years and the commercialization of the turtle eggs by the Chinese. The distance of the habitual breeding grounds of the marine turtles from the agents of the law together with the inadequate protection of the turtle eggs by the government also accounts for the apparent depletion of this important commercial marine product.

COMMERCIAL FISHES

The sharks and sharkfins.—There are around fourteen species of sharks found in the Zamboanga and Sulu waters. Sharks are apparently abundant in these waters. The Moro fishermen occasionally fish them for their fins and partly for their flesh. They have greater utility than any other true fish. In the United States and in Europe, practically all parts of the body of the shark are utilized. The liver is a good source of medicinal and industrial oil. The skin gives a fine quality leather for the manufacture of the most expensive scabards and coverings for sword grips, certain expensive Morroco bindings, covering for jewel boxes, etc. The crude skin can be used for polishing cabinet material. The flesh is used for food, fishmeal and fertilizer. The shark meat is sometimes canned but usually under a certain trade name where the identity of the fish is concealed. The offal is made into fishmeal and fertilizer.

The cartilagenous skeletons are made into gelatine, high quality glue and many other products. The fins are important article of trade.

In Zamboanga and in the Sulu regions the fins are the most important parts of the sharks utilized commercially. The flesh is but a secondary product although it is also used for food by the Moros. The shark fins are generally classified into two groups, namely, the white and the black fins although none of the fins are perfectly white nor perfectly black. The white fin is drab and the black fin is dark gray. One of the most expensive soup known as *aletas de tiburon* served in Manila Chinese restaurants and hotels is made from the shark fins. The dried shark-fins are classified into several groups of different values, depending upon the color, size and variety, as follows:

White Fin Variety

1st grade—*Boon leong sit* of the Chinese or the *Mano-mano* or *Malo-malo* of the Moros. It is the large white-spotted fin. It is the most expensive of all shark-fins.

2nd grade—*Chu sit.* It is like the large white-spotted fin in size but without the scattered white spots. Under this grade are admixed the small white spotted fins taken from small or young sharks of the same species where the large white-spotted fins are taken.

3rd grade—*Peh sit.* It is the white fin without the scattered white spots but smaller in size, apparently taken from smaller and younger sharks.

4th grade—*Khiam sit* of the Chinese and *pindong of the Moros.* It is the poorest grade of the white fins, being small and rough in texture.

Black Fin Variety

1st grade—*Tua sit* of the Chinese or the *tamamambojan* of the Moros. It is the largest size of the dark-colored fins. In value it may be classified under the second grade of the white fin variety.

2nd grade—*Oh Ku sit* of the Chinese or *totong* of the Moros. It is gray with a jet-black tip. It may be classified as the 5th grade under the white fin in value.

3rd grade—*Oh sit.* This grade consists of the young and small fins of the species that yields the large black fin. Under this grade is admixed the *seow oh sit* of the Chinese or the *galanbu* of the Moros. They are small gray fins with darker margins. This grade may be classified in value as the 6th grade under the white fin variety.

In 1913 the Department of Mindanao and Sulu exported shark fins valued at 17,408 pesos, and during the first four months of the year 1914, the fins exported were valued at 17,616 pesos.

A total of 155,915 kilograms of shark fins valued at 235,456 pesos was exported from the Philippines during the years 1920 to 1935, or at the average of 9,745 kilograms valued at 14,716 pesos yearly. About 90 per cent of this exportation came from Zamboanga, Basilan and Sulu. The statistical record of exportation for the years 1936 to 1941 is not available.

The sea horse.—The sea horse is a fish belonging to family Syngnathidae. Under this family are about twenty-six different genera and species reported from the Philippine waters. About half of them is found in the Zamboanga, Basilan and Sulu waters. The ones commercialized are the species under the genus *Hippocampus* of which there are three species namely, *Hippocampus kuda* Bleeker, *H. spinosissimus* Weber, and *H. longirostris* Cuvier.

The first one is actually reported from the area and the other two were reported from the neighboring or adjacent waters so that it is probable that the three species are found in Mindanao and Sulu Reefs. The extensive vast coral reefs in the Zamboanga, Basilan and the Sulu waters account for the abundance of this minor but expensive marine product. They are dried and sold at no less than 8 pesos per kilo locally. Dried seahorse is used by the Chinese for medicinal purposes. In China and in other oriental countries where they are exported it is said that it costs three to four times as much.

Lately, the seahorse has found a new commercial use for ornamental purposes. The South Seas Marine and Jungle Products used to buy them at the rate of 9.50 pesos a kilo. They were being fixed, oriented and varnished for ladies' hat ornament, and for other purposes.

The fresh and brackish water fishes.—The fresh-water fishes in Zamboanga and Sulu were not given any importance before the last war due to the abundance of fishes caught from the sea and from fishponds. It was only during the war when there was scarcity of fishes due to the non-operation of most of the fishponds and the control of marine fishes by the enemy when the mud and river fishes were resorted to for food. Generally, in times of bad weather when sea fishing is not possible, some people resort to river fishing. This is actually true in northern Zamboanga where there is a distinct fishing and non-fishing season in the sea. From June to November the people depend mostly on fishes caught from rivers, fishponds and other fresh water sources.

The true fresh water fishes in the place are the mud fishes and some river fishes which are not migratory in habit. They are represented by few species, namely; *Anabas testudineus* (Bloch)—Climbing Perch (Puyo), *Barbodes quinquemaculatus* (Seale and Bean)—Cyprinid (Pait), *Clarias batrachus* (Linnæus)—Catfish (hito), *Nematabramis alestes* (Seale and Bean) Cyprinid, *Ophicephalus striatus* Bloch—Murrel (aluan), *Rasbora philippina* Günther—Cyprinid (pait), *R. punctulatus* Seale and Bean—Cyprinid (pait) *R. lateristriata* Herre—Cyprinid (pait), and *Trichogaster trichopterum* (Pallas)—Osphronemid (plasalid).

The brackish water fishes are represented by the fishes which usually enter rivers, fishponds and lakes. The following are some of the fishes caught inside fishponds and rivers of the place:

Anguilla mauritiana Bennett—Eel (tagibus).
Teuthis sp. (Two species—Siganid (budlung, balawis).
Anadontostoma chacunda (Hamilton Buchanan) Gizzard shad (Tatik).
Arius sp.—Catfish (Kaguk).
Chanos chanos (Forskal)—Milkfish (banglis).
Lates calcarifer (Block)—Sea bass (matakaring).
Gerres filamentosus—Silver perch (bansa, malakapas).
Gerres abbreviatus—Silver perch (bansa, malakapas).
Lutjanus argentimaculatus (Forskal)—Snapper (ahaan).
Megalops cyprinoides Broussonet—Tarpon (abulong).
Mugil dussumieri Cuvier & Valenciennes Mullets (banak).
M. macrolepis Smith—Mullets (banak).
Hemiramphus quoyi Cuvier & Valenciennes—Halfbeak (bamban).
Leiognathus equulus—Leiognathids (sapsap).
Ophiocara porocephala (Cuvier & Valenciennes)—Eleotrids (kapalo).
O. aporos Bleeker—Eleotrids (kapalo).
Glossogobius giurus Buchanan-Hamilton—Eleotrids (Dolog).
Scatophagus argus (Linnæus)—Spadefish kitang).
Toxotes jaculator (Pallas)—Archer fish (isdang, sumpit).
Pristis microdon Latham—Sawfish (pilas).

MARINE FISHERIES

The marine fisheries though not fully exploited for lack of modern and more effective fishing gear are the most important sources of fishes in Zamboanga and Sulu. The fishing gears of the native fishermen are very primitive. The most common gear used is the shallow water fish corral locally known as *bunsod*. Other fishing gear used are the *ambit* or *ampas*, a set of several fishing nets joined together during the actual operation and in conjunction with several vintas; the *redi*, a drag

net seine made of cotton used in shallow sandy or muddy shores; the *atarraya* or *taraya,* a cast net usually operated in conjunction with a fishing vinta; the *lantao,* a drift gill net placed against the current; the *bobo,* a bamboo fish trap for catching coral fishes and bottom dweller fishes among coral reefs; the *bintol* used for catching deep-sea crabs, *Ranina dentata,* and a set of hooks and line. The Christian fishermen use a more effective fishing gear like the *chinchorro,* a seine of from 250 meters to 700 meters long for catching school of pelagic fishes; the *pukot,* a small haul seine of abaca cloth operated in shallower water near the shore in conjunction with several fishing vintas equipped with luminous light; the *sangab,* a round haul seine of cotton twine which is apparently similar to the *sapiao* or *lawag* operated in conjunction with several fishing vintas equipped with luminous light in deeper water far from the shore. Some of the introduced modern fishing gears by the Japanese fishermen are the Pole and line with live baits operated in conjunction with powered motor boat for catching tuna fishes in the open seas; the long line, a very long drift line supported by floats operated in conjunction with a motor boat for catching large fishes in the open seas and the *Muro-ami,* a submerged trap net composed of a landing bag about 188 feet wide with two wings made up of several pieces of rectangular nets of about 56 feet long and 35 feet deep for catching bottom dwellers and coral reef fishes and operated in conjunction with a motor boat and several flat-bottom sampans. At present, all these introduced modern fishing gears are not in operation after the Japanese were driven away from the island.

The primitive fishing gears used by the Moro fishermen are the most common and those by the Christian Filipino fishermen can be counted only by the fingers. What is worst is that illegal fishing with the use of explosives and poisonous substance is still rampant in the place. The fisheries are on the verge of destruction by the illegal methods of fishing. In fact, several known fishing grounds have already been depleted due mainly to illegal fishing.

Certain localities in the Zamboanga and Sulu waters where commercial fishes were abundant have acquired a reputation as fishing centers. Such places are Margosatubig, Domanquilas Bay, Tumalong Bay, Maligay Bay, Malbug Bay, Pagadian Bay, Locsico Bay, Busan Bay, Bangaan Cove, Caldera Bay, Sibuco

Bay, Siocon Bay, Sindangan Bay, Dapitan Bay, Dipolog, Bohelebong, Lampinigan, Sanboy, Malanipa, Sulade, Tapul, Tumbagaan, Simor, Manuc-manca, Tataan, Lahat-lahat, Doc Can, Malicut, Tumindao, and Sitankai vicinities. Zamboanga, Margosatubig, Jolo, Siasi, Bongao and Sitankai are the most important fishing centers where the different aquatic products are commercialized.

Some of the pelagic and demersal fishes of commercial importance are:

Scientific name	English common name	Local name
Auxis thazard	Bonito	Tuliñgan, Maniko.
Siganus vermiculatus and 16 other species	Siganid	Samaral, bulong, balawis, bawis, dangit, bunlong, mang-lap dag, bel-long.
Coryphaena hippurus	Dolphin	Dorado.
Cybium commerson	Spanish mackerel	Tanigue, tangi.
Caranx sexfasciatus and 7 other species	Crevalle	Tarakitok, isda puti, ladiwak, tampaan, landiok, mangali, takolukan, lumasang, mamsa, daing puti.
Dussumieria hasseltti	Round herring	Tamban, kasig.
Euthynnus yaito	Yaito tuna	Tuliñgan, sobad, katchorita.
Elagatis bipinnulatus	Runner	Ulong-ulong, ong-ong, tengteng, tangtang.
Katsuwonus pelamis	Skipjack or striped tuna	Sobad, puyan.
Makaira mitsukuri	Marlin	Kandayan, kandelan.
Istiophorus orientalis	Marlin	Kandayan, kandelan.
Megalaspis cordyla	Hardtail	Cubal-cubal, tulay.
Mugil (8 species)	Mullet	Lisas, Talilong, Banak
Neothunnus macropterus	Yellowfin tuna	Tambakol, panit.
Parathunnus sibi	Big-eye tuna	Tuliñgan, panit.
Rastrelliger brachysomus	Short bodied mackerel	Cavallas.
Rastrelliger chrysozonus	Striped mackerel	Cavallas, andohao; salay-salay.
Sardinella leiogaster	Herrings	Tamban tuloy.
S. perforata	Herrings	Tamban lapad.
S. fimbriata	Herrings	Tamban lapad.
S. melanura	Herrings	Tamban lapad.
S. sirm	Herrings	Tamban haol-haol.
S. longiceps	Herrings	Tamban tuloy.
Seriola sp.	Yellow tail; amberjack	Lumasang.
Selar crumenophthalmus	Big-eye scad	Katambak, tulay, matang vaca.
Scomberoides toloo	Leather jacket	Lapis, kalang-kalang
S. lysan	Leather jacket	Lapis, kalang-kalang
Sphyraena jello	Barracuda	Pangaluan, rompecandado, Lambana, tindik-tinduk, bangasa.
S. obtusata	Small barracuda	Lambana, tindik-tinduk, bangasan.
S. picuda	Large barracuda	Pangaluan, rompecandado.
Stolephorus commersonii	Anchovy	Bolinao, anakbat, dilis, talika.

S. indicus	Anchovy	Bolinao, anakbat, dilis, talika.
S. tri	Anchovy	Bolinao, anakbat, dilis, talika.
S. heterolobus	Anchovy	Bolinao, anakbat, dilis, talika.
Thunnus thynnus	Bluefin tuna	Tuliñgan, panit.
Xiphias gladius	Swordfish	Manumbok, malasugi.

The following are commercial bottom dwelling fishes which inhabit mostly the coral reefs and rocky bottoms of the Zamboanga and Sulu waters:

Scientific name	English common name	Local name
Anyperodon leucogrammicus	Grouper	Budyunga, mantis, tapog, patikan.
Argyrops spinifer	Pargos	Gaud-gaud.
Amblypomacentrus breviceps	Damsel fish	Laslas, tibu-tibuk, ulan-ulan.
Amblyglyphidodon aureus	Damsel fish	Laslas, tibu-tibuk, ulan-lan.
A. curacao	Damsel fish	Laslas, tibu-tibuk, ulan-ulan.
A. leucogaster	Damsel fish	Laslas, tibu-tibuk, ulan-ulan.
Caesio (6 species)	Caesio	Sulig or sulid.
Chaetodon (23 *speciesi*)	Butterfly fish	Bebang, isda kabakaba.
Choerodon (6 species)	Wrasse fishes	Bangkilan, bankolis, pollak, pollay, tallad, tumaling, lampit, pejakan, lamon.
Chelinus (9 species)	Wrasse fishes	Mammi, mamming, langkan.
Cromileptes altivelis	Grouper	Kulapu, patikan, tapog.
Drepanichthys punctatus	Eastern spadefish	Mayang, riring, siguing.
Dischistodus (6 species)	Damsel fishes	Las-las, tibu-tibuk, ulan-ulan.
Epinephelus (19 species)	Grouper	Mantis, kotkot, kumbokumbo, pugapo, kulapu, lapulapu.
Eupomacentrus lividus	Damsel fish	Las-las, tibu-tibuk, ulan-ulan.
E. nigricans	Damsel fish	
Gymnocranius griseus	Nemipterid	Kulambal.
Glyphisodon (6 species)	Damsel fishes	Las-las, tibu-tibuk, ulan-ulan.
Glyphidodontops (7 species)	Damsel fishes	Las-las tibu-tibuk, ulan-ulan
Hepatus (17 species)	Surgeon fishes	Indañgan, darong.
Halichoeres (29 species)	Wrasse fishes	Lampit, etc.
Iredaleichthys (5 species)	Damsel fishes	Las-las, tibu-tibuk ulan-ulan.
Lethrinus (19 species)	Porgy	Lauso, kulambal, kotot, bagangan, kutambak, bitilla sampok, gaudigaud
Leptoscarus moluccensis	Parrot fish	Mulmul.
L. vaigiensis	Parrot fish	Mulmul.
L. viridescens	Parrot fish	Mulmul.
Lutjanus (23 species)	Snappers	Calumbang, bacbaan, camang-baku, leppe, mangagat, bakuko, bigaong, bitilla, dapak, langisi, bahabak, mayamaya, etc.
Mulloidichthys auriflama	Goatfish	Tangbod, timbuñgan.
Mulloidichthys samoensis	Goatfish	Tangbod, timbuñgan.
Monotaxis grandoculis	Lethrinids	Malaking mata, lagao.
Monodactylus argenteus	Leaf fish	Bayang-bayang, buna.
Naso (11 species)	Surgeon fish	Kumai.

Nemipterus (8 species)	Nemipterid	Bisugo, kulisi, pukit.
Parupeneus (14 species)	Goat fishes	Tangbod, tiao, timbuñgan.
Priacanthus hamrur	Big eye	Baga-baga, tihik-tihik. lambi, kanda-aman.
Priacanthus macracanthus	Big eye	Baga-baga, tihik-tihik, lambi, kanda-aman.
Plectorhinchus (9 species)	Grunts	Manila, pasinco, labia, gollabao, lepe bato.
Pelatis quadrillineatus	Therapon	Babansi, bagaong.
Pentapodus (5 species)	Lethrinids	Besugo, bakutot.
Platax orbicularis	Leaf fish	Banak, buna.
Pomacentrus (5 species)	Damsel fishes	Las-las, tibu-tibuk ulan-ulan.
Paraglyphidodon (6 species.)	Damsel fishes	Las-las, tibu-tibuk ulan-ulan.
Parapomacentrus albolineatus	Damsel fishes	Las-las, tibu-tibuk ulan-ulan.
P. ovoides	Damsel fishes	Las-las, tibu-tibuk ulan-ulan.
Pseudopomacentrus (7 species.)	Damsel fishes	Las-las, tibu-tibuk ulan-ulan.
Stethojulis (8 species)	Wrasse fish	Lampit, bukan, tallad, lamon, pejakan.
Scarichthys auritus	Wrasse fish	Lampit, bucan talled, lamon, pejakan.
S. coeruleopunctatus	Wrasse fish	Lampit, bucan, tallad, lamon pejakan .
Scarus (32 species)	Parrot fishes	Mulmol, ugos buntog
Scolopsis (11 species)	Grunts	Tagisang lawin, langin.
Sparus berda	Pargos	Bakoko.
Thalasoma (7 species)	Wrasse fishes	Lampit, bucan, tallad, lamon, pejakan.
Therapon (4 species)	Theraponids	Bagang, langot.
Upeneus (6 species)	Goat fishes	Timbungan, tanhug, mauntot.
Kyphosus cinerascens	Rudder fish	Ilak
K. vaigiensis	Rudder fish	Ilak
Zanclus canescens	Coral fish	Kalmin-kalmin. Kambing-kambing.
Zebrasoma flavescens	Surgeon fish	Katol-katol.
Z. veliforum	Surgeon fish	Katol-katol.
Platycepholus indicus	Flathead	Sunog, uram-uram, kamang, buaya.

Salted fish products—Among some of the important fishery products derived from the fishes taken around Zamboanga and Sulu are the salted fish products known as *bagoong-dilis, bolinao, lupoy* and *tamban.* The anchovies and herrings (sardines) are salted in the proportion of ten 5-gallon cans (petroleum can) of fresh fish to 1⅕ sacks (60 kilos sack of the Zamboanga salt, and placed in petroleum cans, sealed and stored for about a week before marketing.

Dried fishes are other important fishery products. The anchovies are usually dried without salting. The sardines and other bigger fishes are salted in brine for few hours depending upon the size of the fish before drying. Among the Moros the bigger fishes are dried without salting but the product is not usually commercialized although occasionally some are offered for sale in the local markets. The commercial dried fishes are classified into five classes or grades. The tarakitok represented

by the different species of *Caranx* constitutes the first grade; the *anofin, mangagat, sulig,* etc. represented by the different species of *Lutjanus* and *Caesio* constitute the second grade; the *kotot, kulambal,* etc. represented by the different species of *Lethrinus* constitute the third grade; the halfbeaks, groupers, etc. represented by the different species of *Hemiramphus, Epinephelus,* etc. constitute the fourth grade, and all other fishes mostly rock fishes represented by the different species of *Scarus, Upeneus* and others constitute the last grade.

Binoro is another fishery product. Medium size fishes like the herrings and chub mackerels, and others are salted dry and packed in boxes or in baskets and stored for at least a week before marketing. Canned tuna, fish meal, frozen livers and salted belly of tuna were the fishery products produced by the former Sea Foods Cannery at Zamboanga before the last World War.

REFERENCES

BLANCO, G. J., and F. E. ARRIOLA.

1937. Five species of Philippine shrimps of the genus *Penaeus.* Phil. Jour. Sci. 62 No. 2.

DOMANTAY, J. S.

1933. Littoral holothurioidea of Port Galera Bay and adjacent waters. Nat. App. Sci. Bull. 3 No. 1.

1934. Four additional species of littoral holothurioidea of Port Galera Bay and adjacent waters. Nat. Appl. Sci. Bull. 4 No. 1.

1934. Philippine commercial holothurians. Phil. Jour. Comm. 10 No. 9.

1936. Philippine edible holothurians. The Searchlight. 1 No. 1.

1938. Report on the marine fauna of Ulugan and St. Paul's Bays, Palawan. Nat. Res. Coun. Bull. No. 22.

1938. Report on the marine fauna of the western part of Lingayen Gulf. Nat. Res. Coun. Bull. No. 22.

1938. Note on the invertebrate fauna of Sakul Island Lagoon, Zamboanga. Phil. Jour. Sci. 65 No. 3.

1938. Tuna canning in Zamboanga. Ind. Agr. and Comm. Jour. 5 No. 7.

1940. The catching of live baits for tuna fishing in Mindanao. Phil. Jour. Sci. 73 No. 3.

1940. The fishing industry of Margosatubig. Phil. Jour. Sci. 72 No. 4.

1940. Tuna fishing in Southern Mindanao. Phil. Jour. Sci. 73 No. 4.

1940. The fishery industries of Zamboanga. Phil. Jour. Sci. 71 No. 1.

DOMANTAY, J. S. and H. A. ROXAS

1938. The littoral Asteroidea of Port Galera Bay and adjacent waters. Phil. Jour. Sci. 65 No. 3.

ESTAMPADOR, E. P.
1937. A check-list of Philippine crustacean decapods. Phil. Jour. Sci. 62 No. 4.
HERRE, A. W.
1923. A review of the eels of the Philippine Archipelago. Phil. Jour. Sci. 23 No. 2.
1923. Notes on Philippine shark. Phil. Jour. Sci. 23 No. 1.
1924. Distribution of the true fresh-water fishes in the Philippines. Phil. Jour. Sci. 24 No. 3.
1925. Notes on Philippine shark, II. Phil. Jour. Sci. 26 No. 1.
1926 A summary of the Philippine catfishes, order Nematognathii. Phil. Jour. Sci. 31 No. 3.
1927. Philippine surgeon fishes and Moorish idols. Phil. Jour. Sci. 34 No. 4.
1927. Gobies of the Philippines and the China Sea. Bu. of Sci. Monog. No. 23.
HERRE, A. W. and H. R. MONTALBAN.
1927. The Philippine species of Kuhlidae. Phil. Jour. Sci. 33 No. 2.
1927. Philippine sparoid and rudder fishes. Phil. Jour. Sci. 33 No. 4.
1927. The Philippine butterfly fishes and their allies. Phil. Jour. Sci. 34 No. 1.
LENDENFELD R. VON.
A monograph of the horny sponges. Triibe 7 Co. London. Published for the Royal Society, 188.
MARTIN, C. and H. R. MONTALBAN.
1934. Philippine sillaginidae. Phil. Jour. Sci. 55 No. 3.
MONTILLA, J. R.
1935. A review of Philippine menidae and gerridae. Phil. Jour. Sci. 58 No. 2.
MONTALBAN. H. R.
1927. Pomacentridae of the Philippine Islands. Bu. of Sci. Monog. No. 24.
ROXAS, H. A.
1928. Philippine Echinoidea. Phil. Jour. Sci. 36 243–270.
1934. A review of Philippine mugilidae. Phil. Jour. Sci. 54 393–431.
1934. A review of Philippine isospondylous fishes. Phil. Jour. Sci. 55 231–295.
ROXAS, H. A. and C. MARTIN.
1937. A check-list of Philippine fishes. Dept. Agr. and Comm. Tech. Bull. No. 6.
SEALE, A.
1916. Sea products of Mindanao and Sulu, I: Food fishes and sharks. Phil. Jour. Sci. 2 Sec. D, No. 3.
1916. Sea products of Mindanao and Sulu, II: Pearls and pearl shells and button shells. Phil. Jour. Sci. 2 Sec. D, No. 4.
TALAVERA, F.
1930. Pearl fisheries of Sulu. Phil. Jour. Sci. 43 No. 4.
TALAVERA, F. and L. A. FAUSTINO.
1935. Industrial shells of the Philippines. Dept. Agr. and Comm. Pop. Bull. No. 5.

TAYLOR, E. H.
1921. Amphibians and turtles of the Philippine Islands. Bu. of Sci. Publ. No. 15.
VILLADOLID, D. V.
1937. Philippine commerce of fish and fishery products from 1916 to 1935. Agr. and Ind. Monthly. 5 No. 1.
1938. The migratory fishes of the Philippines and problems affecting their conservation. Agr. and Ind. Monthly. 5 No. 6.
WILSON, H. V.
1925. Silicious and horny sponges collected by the U. S. Fisheries Steamer "Albatross" during the Philippine Expedition, 1907 to 1910. Smith. Inst. Nat. Mus. 100 2 No. 4.

SOCIO-ECONOMIC PROBLEMS AFFECTING THE PRODUCTION, PROCESSING AND DISTRIBUTION OF FISHERIES PRODUCTS

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CAPITAL AS A PROBLEM

In production.—In spite of the intrinsic value of fish in the daily life of a large segment of the Philippine population, fishing has been a neglected industry. Private and public banks, bound by existing stringent regulations in their charters, give very little financial aid to the fishing industry. As a result, very little headway has been achieved in the overall development of this industry to its maximum potentiality. Cash advanced by usurious capitalists in the form of loans at the start of any fishing venture for operation expenses, places the fish catch in their full control. Likewise, for necessary repairs and overhauling of vessels and fishing paraphernalia, these capitalists also extend loans, thus gaining control of future catches.

The production cost of fresh fish is relatively high and is estimated at about 32 centavos per kilogram for the 15 kinds of commercial fishing gear commonly used in the Philippines. This is brought about by the present high cost of fishing equipment and supplies, such as marine engine, fishing nets, fuel and ice, which are mostly imported. The cost of labor is also considered high due to the fact that most fishing vessels are over-manned as per requirement by customs regulations. Corrective measures, are, however, being looked into.

In processing and distribution of fisheries products.—Similarly, usurious capitalists, mainly aliens, poach on local fish processing units by supplying most of the capital. In this way, fisheries products are marketed by such capitalists and their control of the industry is so complete that they practically dictate their prices. The hundreds of thousands of local fishermen become enslaved by the usurious practices of just a group of middlemen composed mostly of aliens. The high cost of salt and containers also contributes much to high production and handling costs.

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GOVERNMENT ACTION IN SOLVING THE PROBLEM

In production.—Although financial aid has been provided by the government, through the Philippine National Bank (PNB) and the Rehabilitation Finance Corporation (RFC)[2], credit facilities are limited and with more emphasis on the fishpond industry, thus leaving out the greater bulk of the fishing industry at the mercy of usurious capitalists.

The Philippine National Bank has extended loans to the agricultural industry, of which outstanding fishery loans as of January 31, 1957, amounted to as follows:

Fishpond and inland fishing	₱5,704,436.92
Marine fishing	1,673,410.99
Total	₱7,377,847.91

The Rehabilitation Finance Corporation, likewise, has outstanding loans of about 22,110,109 pesos as of December 31, 1956, for the fishpond industry. Of this amount 11,981,530 pesos went to privately-owned fishponds (private lands converted into fishponds) and 10,128,579 pesos were distributed among government leased fishponds (government land leased to individuals for fishpond purposes). The RFC loan was intended for improvements of already constructed fishponds in order to increase production and also for new areas ready to be converted for brackish water fish culture.

The small fishermen, owners of fishing boats of less than 3 tons gross, who comprise the greater portion of the fishing population and operating in shallow waters within the jurisdiction of municipal governments (within the 3-mile limit), are left out. Their inability to provide adequate securities for loans, as required by local banks and other loaning establishments, deprives them of such financial assistance and thereby forces them to acquire loans from individual capitalists.

In a cursory study of the economic status of the ordinary fisherman, it was found out that his net earning out of every peso amounts to only 15 centavos and the rest is distributed in the form of labor expenses, fish broker fees, refrigeration and transportation expenses, and profits for retailers. This situation contributes to a large extent in making the lot of the ordinary fishermen miserable and consequently have a very

[2] Renamed Development Bank of the Philippines (DBP).

low standard of living as compared to other agricultural workers. There is no concerted effort in increasing fish production, crude and wasteful fish processing methods exist, and the control of trade and marketing is handled by very few individuals.

In processing and distribution of fisheries products.—In view of this deplorable situation, the government decided to give more incentive to the fishermen, especially to small operators, by extending more liberal credit facilities. Republic Act No. 821, as amended by Republic Act No. 1285, approved on August 14, 1952 and June 15, 1955, respectively, made possible the creation of an agency called the "Agricultural Credit and Cooperative Financing Administration (ACCFA)" with the primary purpose "to place agriculture (including livestock, poultry and fishing) on a basis of economic equality with other industries". The main objective of the entity is to provide adequate financial aid and cooperative marketing of the produce. The former is in the form of loans and the latter through the organization of Farmers-Fishermen Cooperative Marketing Associations (FACOMA) and the establishment of the Central Cooperative Exchange (CCE).

However, it is the opinion in high quarters in the ACCFA that marine fishing is not under the scope of Republic Act No. 821, as amended by Republic Act No. 1285. It is for this reason that only the fish processing industry is financed by this government entity in the meanwhile. As far as fishing operations in marine waters are concerned, the ACCFA is constrained to extend adequate financial aid as this phase in the fishing industry is not precisely provided for in the existing law creating the aforesaid agency. Although the craft/gear improvement loan and the dry-docking loan is extended, the maximum amount allowed is 2,000 pesos only for each fisherman or boat owner, with the vessels, gear, or pledged produce as security. It is, however, hoped that further amendments to the law will be made in the future and at such a time when the bulk of the business, in line with fisheries, will warrant the inclusion of marine fishing in the agency's activities.

The different ACCFA loans are described as follows:

(*a*) *Production loan*—

Amount: Not more than 60% of the value of the pledged produce but not more than 2,000 pesos based on prior year production and current prices.

Terms: Payable in one year at 7% interest per annum. Part of monthly installments may be collected from the sales of the member's produce.

Security: Pledged produce (delivery of total produce.)

(*b*) *Commodity loan*—

Amount: Not more than 80% of the value of the delivery based on current prices prevailing.

Terms: Payable in 90 days at 6% interest per annum. Part may be collected from sale of produce. For fermented fish sauce (*patis*)—180 days; and for repacked salted fish paste (*bagoong*) and fermented fish sauce—120 days.

(*c*) *Dry-docking loan*—

Amount: Not more than 10% of the value of the pledged amount in the marketing agreement but not more than the following:

5 to 15 tons vessels—1,000 pesos.
16 to 20 tons vessels—1,500 pesos.
21 and up tons vessels—2,000 pesos

Terms: Payable in one year at 7% interest.

Security: Fishing craft and regular deliveries of produce for at least 6 months.

(*d*) *Craft/gear improvement loan*—

Amount: Value of excess product delivered to products pledged but not more than 2,000 pesos.

Terms: Length of life of craft/gear at 8% interest. (1) For two years period-monthly installments. (2) For five years period—annual installments.

Security: Fishing craft/gear and regular deliveries of produce for at least 6 months.

(*e*) *Facility loan*—

Amount: Equal to full value of containers but not more than 25,000 pesos to a FACOMA.

Terms: Payable in one year in two semiannual installments at 8% interest.

Security: Real estate or fishing craft but not more than 50% of the appraised value.

(*f*) *Merchandizing loan*—

Amount: Value of salt, rice, fuel, etc. needed by the members during no operation.

The ACCFA set a program to establish marketing cooperatives for fishermen patterned after the Farmers Cooperative Marketing Associations (FACOMA). The economic survey undertaken in the ten target areas for the establishment of such fishermen FACOMAS revealed that such fishermen cooperatives will involve about 23,400 commercial fishermen with a total

existing investment of about 15,800,000 pesos in craft and gear and which will give a combined total annual production valued at about 27,000,000 pesos.

In the organization of fishermen cooperative marketing associations, membership is open to any fisherman or operator of a fishing vessel living in a particular locality. In view of the present conditions, fishermen cooperatives are formed as a department of existing FACOMAS which are located in fishing districts.

Various loans were already approved for some of the fishermen FACOMAS which were needed in their business undertakings. As of April, 1957, the status of loans extended to the ten priority fishermen FACOMAS were as follows:

Location	Original members	Paid-up capital	Approved loans			Nature of business
			Facility	Commodity	Merchandizing	
	Number	*Pesos*	*Pesos*	*Pesos*	*Pesos*	
(a) Farmers-fishermen:						
1. Batad Iloilo	25	2,000	10,000	-------	-------	Dried fish
2. Balatan Camarines Sur	25	2,000	10,000	-------	-------	Fish meal
3. Calabanga Camarines Sur	Under	process	of organi	zation		Fresh fish
4. Catbalogan Samar	Under	process	of organi	zation		Dried fish
5. Coron, Palawan	25	2,000	25,000	40,000	60,000	Fish paste (salted)
6. Mercedes, Camarines Norte	25	2,000	[b]	-------	-------	Dried, smoked fish
7. Oas, Albay	25	2,000	[b]	-------	-------	Dried fish
8. Sta. Ana, Cagayan	25	2,000	10,000	-------	-------	Fish paste (salted)
(b) Specialized fishermen:						
9. Bantayan, Cebu	Under	process	of organi	zation		Fresh dried fish
10. Navotas, Rizal	55	7,500	[b]	-------	-------	Fresh dried fish (fish paste and sauce)
Totals	205	19,500	55,000	40,000	60,000	

[a] Part of the 130,000 pesos earmarked for fish meal by the CCE.
[b] Loan applications under process by ACCFA.

Four ice plants are earmarked by the ACCFA, under ICA-NEC aid, to be established during the fiscal year ending June 30, 1957. The specialized fishermen FACOMA, located at Navotas, Rizal, will have a 500,000 pesos ice plant. This FACOMA will market fresh fish produced by member-fishermen aside from its proposed patis (fermented fish sauce) and bagoong (salted fish paste) processing and dried fish plants. The other ice plants, valued at 150,000 pesos each, will be located at Calabanga, Camarines Sur; Coron, Palawan; and Mercedes, Camarines

Norte. Out of the ICA-NEC aid, the ACCFA has also earmarked a 10,000 pesos fish canning plant to Oas, Albay.

Noteworthy of mention is the Parañaque (Rizal) Salt FACOMA which has a paid-up capital of 2,000 pesos. This FACOMA supplies the salt requirement of other FACOMAS, either for household consumption of members or for fish processing plants, especially in the fermented fish sauce and salted fish paste processing plants, which are operated by other FACOMAS. This organization exists as a department of the established farmers FACOMA in that locality. Loans have already been extended to this FACOMA as follows:

Kind of Loan		Remarks
1. Facility Loan	₱34,160.00	Warehouse and sacks
2. Commodity Loan	9,500.00	Salt produce
3. Production Loan	59,849.00	Pledged produce
Total	₱103,509.00	

The Central Cooperative Exchange (CCE) undertakes the marketing of the salt produce at standard prices for delivery to any existing FACOMA placing orders throughout the country.

One interesting fact in the establishment of fishermen FACOMAS is that non-members thereof can also deliver their produce for deposit and/or marketing, provided that the amount does not exceed 50 per cent of the members' deliveries. With this policy, it is hoped that such fishermen who may have some doubts in this cooperative marketing movement, will ultimately decide to become members, thereby depriving unscrupulous capitalists, mostly aliens, of their illegal operations. With this cooperative marketing system, people living even in the remotest parts of the country can be readily supplied with their fish requirement.

FURTHER PLANS OF THE GOVERNMENT AGENCY (ACCFA)

An overall economic survey of the fishing districts in the Philippines, as undertaken by field agents of the ACCFA, revealed the existence of inadequate refrigeration facilities and the antiquated and wasteful methods of fish processing. Crushed ice commands high prices, if available at all, at some fish landing points which results in high prices of fresh fish. Rural people living in interior parts of the country cannot, therefore, avail themselves of their requirements for fresh fish. Imported

canned fish becomes their chief source of fish food. Transportation facilities are either inefficient or inadequate, thus adding more to such deplorable conditions. With the establishment of more ice plants, the ACCFA hopes to solve this problem.

REFERENCES

1. Manacop, Porfirio R., "ACCFA Financing Program for the Marine Fishing Industry, 1956 Mimeog.
2. Economics and Statistics Departments, PNB and DBP, 1957 (by letter).

CONTROL OF LESS DESIRABLE EXOTIC SPECIES OF FISH COMPETING WITH OR HARMFUL TO DESIRABLE INDIGENOUS SPECIES IN INLAND WATERS IN THE PHILIPPINES.[1]

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ABSTRACT

Control of the propagation and growth of exotic species of fish that are less desirable because of their comparatively inferior quality of flesh and the competition and harm they inflict on the established indigenous species, is regarded as a problem of the fishpond industry in the Philippines. Effects of the introduction of *Tilapia mossambica* Peters, *Gambusia affinis* (Baird and Girard), *Mollienesia latipinna* (Le Sueur), and Trichogaster spp., which have grown abundantly in fishponds and their control by biological methods, draining and drying of ponds, use of chemical preparations, and use of poisonous substances derived from plants are discussed.

INTRODUCTION

The introduction of exotic species of fish in the Philippines has primarily been an attempt to determine a truly remarkable and suitable fresh-water species for fish culture purposes to boost the exploitation and utilization of inland waters in the country. In contrast to some 2,000 species of marine fish that abound in Philippine waters, there are less than 100 known species of truly fresh-water forms. The absence of an adaptable species that can be successfully and profitably grown for the market and is acceptable to the public palate has deferred the development of 186,688 hectares of fresh-water marshlands and the utilization of 480,000 hectares of lowland rice paddies, 230,000 hectares of lakes, lagoons and rivers, 10,000 hectares of private marginal farm areas, and 5,000 hectares of hydro-electric and irrigation dams and canals for fish culture purposes. Attempt at mosquito control with top minnows or killi-fishes which devour mosquito larvae had also motivated the introduction of exotic fishes in the country.

There are several exotic species of fish introduced in the inland waters of the Philippines (Table 1). The common

[1] Paper read at the 7th session of the Indo-Pacific Fisheries Council, May 13–27, 1957, Bandung, Indonesia (1PFC/C57/TECH 20).

carps, *Cyprinus carpio* Linnæus, which had been introduced several times, have established themselves in some of the important fresh-water lakes, rivers and streams in the country. There are indications that these species have become naturalized. It has even been reported and observed that in some localities, they have acquired the habit of feeding on rice grains that get submerged in the water and even on the soft parts of the stalk of the rice plants. These observations have not been mentioned in literature on common carp in other countries, leading to the speculation as to whether this fish modifies its feeding habits to adapt itself to the type of food present in its new environment.

The giant gourami, *Osphronemus goramy* Lacépède, another introduced species, now grows in artificial ponds and natural waters in most of the provinces of the Philippines. It has become naturalized in several places, particularly in the Bicol region. The black bass, *Micropterus salmoides* Le Sueur abounds possibly only in Trinidad Lake, Baguio, Bontoc, and Ambuklao, Mountain Province, Luzon. The kissing gourami, *Helostoma temmincki* Cuvier and Valenciennes, is newly introduced and has not yet spread in natural waters. The blue gill, *Lepomis macrochirus* Rafferty, is still confined in government fish farms and stations and is cultured by a limited number of cooperators. A species of loach, *Misgurnus anguillicaudatus* (Cantor) had been introduced reportedly by a Japanese some time ago and has been found to be established in fresh-water streams in Mountain Province.

In spite of the efforts of the Philippine Bureau of Fisheries to control the propagation and distribution of introduced species until studies on their biological habits have been made to determine the suitability of their culture under local conditions, some hardy species with rapid growth, multiplication, and almost indiscriminate feeding habits are now growing helter-skelter in milkfish ponds, rice paddies, rivers, streams, lakes and mud holes in salt brackish- and fresh-water situations. The top minnows, *Gambusia affinis* Baird and Girard and *Mollienesia latipinna* Le Sueur, plasalid, *Trichogaster* spp., and tilapia, *Tilapia mossambica* Peters compete successfully with the indigenous species in inland waters and grow in unprecedented abundance in places where their presence is undesirable. As such, they have been regarded as less desirable species, although the minnows have some beneficial effects and tilapia and

plasalid have good table qualities. Their invasion of brackish-water fishponds, resulting in competition with cultivated species, has posed problems of control and eradication.

EFFECTS OF THE INTRODUCTION OF EXOTIC SPECIES THAT HAVE COME TO BE REGARDED AS LESS DESIRABLE

When tilapia was introduced in May, 1950 from Thailand, the nine specimens that survived the trip were stocked in concrete ponds of the Bureau of Fisheries, Dagat-dagatan Fisheries Experiment Station in Malabon, Rizal, Luzon, for observations of the biological characteristics of the fish. However, its rapid rate of growth, multiplication and proclivity to take almost any kind of food made it extremely popular and desired by fish culture enthusiasts, including milkfish or *Chanos* growers, so that its distribution and propagation became uncontrolled. The fish is now found in practically all types of aquatic environment, even in crude ponds and holes deep enough to hold water for at least three to four months. It has even been reported, although not verified, to have been caught with chanos fry along sandy coasts and mouths of rivers of known fry grounds during the fry season in 1956.

Today, tilapia is regarded by milkfish growers as a scourge in *Chanos* fishponds. The general consensus among fishpond operators is that its presence dooms a fishpond to low milkfish production or even to total failure. Of course, the presence of this fish in the ponds may be only one of the factors contributory to decreased fish production or failure.

The propensity of the fish to feed on filamentous algæ, the principal available natural food of milkfish under cultivation in Philippine ponds, had made tilapia a stiff competitor of the cultivated fish. Tilapia in ponds can be seen nibbling algæ in the decomposing stage at a rate much faster than milkfish. Observations reveal that (with tilapia in the ponds) algæ, sufficient to supply the chanos with food until the fish reaches marketable size, are consumed when the *Chanos* has attained only one half of the suitable marketable stage. Unless supplementary feeds are given, fishpond owners harvest the fish after two months, which at such size, has low market value. This risk is run into instead of retaining the fish in ponds to complete the growing periods, which incurs more expense in time, care and maintenance without growth increase.

Algal formation is also affected by tilapia, as evidenced by the plowing movements made by the fish on the greenish growth on the pond bottom. Nest-building, which consists of making a basin-like excavation about a foot or more in diameter and about one half foot in depth, destroys algal formation and even the advanced stages of algal growth.

The stocking rate of milkfish in ponds is influenced by the presence of tilapia. Since the number of tilapia in the ponds is undetermined in most cases, the stocking rate for milkfish is usually decreased to avoid the risk of over-crowding and the resultant small and thin fish that have low market value.

Under prevailing conditions in milkfish ponds, tilapia reaches maturity and spawns at an early age and small size. Atz (1954) pointed out that the prolificness of the fish results in slower growth during the reproduction period, its energies being diverted to reproductive processes. This results in "runting" and the harvest of a large number of tilapia ranging from one to six inches in length, considerably less than the 14-inch length reportedly attainable. The tendency of the tilapia to become stunted in ponds with milkfish seems to be the reason why it does not command good market price and so, is considered less desirable by milkfish growers. Larger-sized fish, ranging from 6 to 10 inches in length, used to sell at ₱1.20[2] to ₱1.60 per kilogram. The smaller fish are priced at 40 to 60 centavos per kilogram and are rarely sold at all.

Reports that tilapia feeds on milkfish fry have been looked into and ascertained, especially under crowded conditions in impoundments. Tilapia is essentially an algal feeder and a vegetarian, but in the absence of vegetable food, it devours with apparent relish, micro-fauna, insects, crustaceans, worms, and small fishes. The injury tilapia causes milkfish fingerlings may be inflicted by the parent fishes during the spawning season, particularly the male, which, according to Atz (1954) behaves with hostility toward other fishes.

Miscellaneous species that are used to bolster fishpond production and income have been observed to become more stunted in growth with the presence of tilapia and have to be sold at low market price, such as the spade fish, *Scatophagus argus* Cuvier, and Valenciennes; mullets, *Mugil* spp.; siganids, *Teuthis* spp.; shads, *Anodontostoma* spp. and *Nematolosa* spp.

[2] Two pesos in Philippine currency is equivalent to one United States dollar.

The top-minnow, *Gambusia affinis* Baird and Girard which was introduced for mosquito control is now widely distributed in fresh and saline waters throughout the Philippines. Seale (1917) noted that this species thrived even with black bass, mudfish, and fresh-water theraponid in controlled and natural conditions. Since it is prolific and a voracious feeder on mosquito larvæ, it competes with milkfish in brackish-water ponds for space and, maybe, also for food.

Mollienesia latipinna Le Sueur, which was accidentally introduced in the country, is found in salt-water ponds, creeks and ponds for salt-works around the Manila Bay area in Luzon (Herre, 1929). Its excessive abundance in milkfish ponds in this region has caused some detriment to the success of the culture of milkfish. Aside from competing for space with the cultivated species, this cyprinodont devours "lablab" a micro-biological complex described as the brownish, greenish, or yellowish crust which develops on the floor of the fishpond nurseries and provides the natural and most favorable food of milkfish fry and fingerlings under cultivation. In rearing ponds, it feeds on filamentous algæ, insects, and insect larvæ and thus compete with milkfish.

The introduced species of plasalid,[3] *Trichogaster pectoralis* Herre, *T. trichopterus* Herre, and *T. leeri* (Bleeker) are found extensively in fresh-water areas and grow in almost wild state. They are seldom desired as food-fish in coastal towns where fish, particularly from marine sources, is common. In interior towns and on farm areas, where it is found in lakes, rivers and rice paddies, plasalid is a favoured table fish in the absence of marine fishes and indigenous fresh-water fishes, such as the climbing perch, *Anabas testudineus* (Bloch); fresh-water catfish, *Clarias* spp.; mudfish *Ophicephalus striatus* Bloch; catfishes, *Arius* spp.; goby, *Glossogobius giurus* (Hamilton and Buchanan); and fresh-water theraponids, *Therapon* spp.

METHODS OF CONTROL

The fish culture stations of the Philippine Bureau of Fisheries and local milkfish growers have tried ways of controlling and eradicating tilapia and other less desirable species. At pre-

[3] An indigenous species, *Trichogaster trichopterum* in a crater lake in Cagayan de Sulu Island, Sulu, had been reported by Herre (1924) and listed by Roxas and Martin (1937).

sent, the control methods consist of: biological control; eradication by thorough draining and drying of ponds; control by poisonous substances derived from plants; and control by special chemical preparations.

Biological control.—Biological control is applied in fishponds where predatory species are present, such as, the sea bass, *Lates calcarifer* Cuvier and Valenciennes; ten pounder, *Elops hawaiensis* Regan; groupers, *Epinephelus* spp. and tarpon, *Megalops cyprinoides* (Broussonet). These predatory species eat up the small tilapia, thus controlling the number and allowing the larger tilapia to grow to much bigger and desirable sizes. The tilapia also serves as forage fish for these predatory species which command good market price. However, these predators have not been observed to feed on *Mollienesia latipinna* Le Sueur, probably owing to the bitter taste of the flesh of the mosquito fish. In fresh-water lakes, rivers and streams, the mudfish and catfishes control the number of tilapia, and to some extent, plasalid. The result is large-sized mudfish and catfish fattened on tilapia fry and fingerlings.

Under this set-up, both the predator or carnivorous fish and the prey or forage fish are both essential components. The main feature of this system is the maintenance of a biological balance between the predator and the prey so that quality products could be produced.

Eradication by thorough draining and drying of ponds.—Fishpond owners use this method of eradicating tilapia and the mosquito fishes and predators such as eels and gobies in milkfish ponds before resorting to any other method because this is the most inexpensive means of control and eradication. Ponds are drained as completely as possible. Pools and depressions are leveled off and the water is bailed or pumped out. In order to make the drying of the ponds more effective, leaks and seepages are looked into. The ponds are left to dry for at least two weeks to kill the pest and predators. To be more certain that all the fish and other organisms at the bottom are killed, water is allowed into the ponds after the drying process. Some species that may have burrowed in the mud during the drying process are induced to come to the surface of the pond bottom where favorable conditions are simulated with the presence of the water in the pond. Then the pond is drained again of water and left to dry for a day or two so that the fish which might have been left in the first drying

process can no longer bury themselves back into the hardened soil and thus die on the surface of the pond bottom. After the ponds have been cleaned, the gates are properly screened with fine bamboo slats to prevent the entrance of tilapia and other undesirable species from the outside.

Control by poisonous substances derived from plants.—The use of piscicides or stupefacients derived from plants in catching fish has been in use in the country since time immemorial. Umali (1953) reported that this illegal method of fishing is still commonly practised especially in interior regions and even along some coastal towns. The preparation of the toxicant involves pounding or crushing of the leaves, roots, fruits, and in some cases, even the whole plant, to extract the juice or sap from which the poison is derived. The juice is extracted and poured into pools of water left by the tide in seashores or in small streams and lakes, or the pulp is squeezed over the water or thrown into the water. The pounded plant may also be mixed with baits and other substances that attract the attention of the fish and the concoction broadcast in the water.

For the control and eradication of tilapia, however, only fish poison derived from the juice of the roots and stems of "tubil", *Derris* spp. and the leaves of "tigau", *Callirpa cana* Linnæus have been commonly and widely used. The roots and stem of tubli are pounded and the leaves of tigau crushed and applied in depressions and holes in the ponds where fish are left behind after drainage and harvest. Fish are reportedly shocked and stunned within 30 minutes to three hours, depending on the size of the fish, water temperature, and volume of water in the depressions. The use of poisonous substances derived from plants to eradicate and control undesirable species in fishponds is very effective, but the supply of the plants is low, reportedly obtainable in mountain forests where they grow in wild state and their preparation is laborious and time-consuming.

There are many plants from which poisons are derived and reportedly used in fishing in the Philippines (see Table 2). These piscicides can be possibly used in the control and eradication of undesirable species of fish and some of these plants are probably already being used in some localities.

Control by the use of chemical preparations.—The use of chemical preparations to control undesirable species of fish in

the Philippines has been resorted to after the invasion of milkfish ponds by tilapia. Control work with D.D.T., both wettable D.D.T. (soluble in water) and technical D.D.T. (soluble in kerosene), Shell 2,4–D and Shell endrin were tried.

D.D.T. applied for control of mosquitoes was observed to kill fish fauna in places where it was sprayed. Wettable D.D.T. reportedly killed fish life in brackish-water at a minimum lethal dose of 0.03 gram per liter of water during sunny days in open ponds. The chemical, which is in the form of powder, is dissolved in water and applied in the areas involved. Technical D.D.T. is sold in 5% solution dissolved in kerosene oil. The lethal dose with this chemical is 7.6 cubic centimeters per liter of pond water when applied on sunny days in open ponds. Repeated washings of the ponds for one week or so has been observed to be sufficient in removing the poisonous effect of D.D.T. (Rabanal, *et al.*, 1956).

Undesirable species of fish in ponds have also been observed to be killed by 2,4–D, a chemical specifically used for the control of broad-leafed weeds. In fresh-water, fish was observed to be killed with a dose of 0.13 cubic centimeter per liter of water. In salt or brackish water, 0.13 cubic centimeter of 2,4–D per liter is also lethal. Repeated washing of ponds for about a week removes the toxic effect of 2,4–D. (Rabanal, *et al.*, 1956).

The effects of Shell[4] endrin, a chemical control agent for rice stem borers, on fish life were tested with tilapia as test fish. These studies were made when it was observed that endrin killed fish in rice paddies where it was sprayed to control rice pests. According to Padlan and Hosillos (1956), a concentration of 0.1 part per million (p.p.m.) of endrin effected a total kill of tilapia ranging from 29 millimeters to 84 millimeters in total length within 10 hours in salt water.

Reports have been received of fishpond owners using this poison to eradicate tilapia in milkfish ponds. Rough application rates are used under different situations and conditions. A bottle of endrin containing 12 ounces of the chemical is mixed with two kerosene cans full of water (about 10 gallons). The solution is applied, after the ponds had been drained, in depressions which retain water after drainage and moist places in the pond area. Fish and other species such as shrimps,

[4] Imported, bottled, and distributed by "The Shell Company of the Philippines, Limited," Manila, Philippines.

crabs, snails, including hardy bottom fauna as the eels and gobies are killed within one hour when enough of the chemical is applied.

The effect of endrin on algæ and other plant life in the ponds is still uncertain. Some observations point to harmful effects while others show positive results on algal growth. The alleged increase in algal growth in ponds as an after-effect of the application of endrin may be attributed to the hormone effects of the chemical. Rice plants sprayed with endrin for pest control are reportedly more enhanced in growth than those sprayed with other chemicals. There are various piscicides, insecticides, fungicides, and other chemical preparations for agricultural purposes that have been observed to be lethal to fish life and may be tested for use in the control and eradication of undesirable species of fish (see Table 3).

SUMMARY

1. Fish introduction in the Philippines has been motivated, primarily, by efforts to find a truly remarkable freshwater species that can be profitably stocked and cultivated in the inland fresh waters. Another reason is an attempt to control mosquitoes which was initiated during the early part of the century.

2. The fresh-water species introduced in the Philippines include the six varieties of common carp, *Cyprinus carpio* Linnæus; one species of "tawes", *Puntius javanicus* Bleeker; one species of "nilem", *Osteochilus hasselti* Cuvier and Valenciennes; three species of plasalid, *Trichogaster* spp., ones species of giant gourami, *Osphronemus goramy* Lacépède; one species of kissing gourami, *Helostoma temmincki* Cuvier and Valenciennes; one species of black bass, *Micropterus salmoides* (Le Sueur); one species of blue gill, *Lepomis macrochirus* Rafferty; one species of loach, *Misgurnus anguillicaudatus* (Cantor); two species of top minnows, *Gambusia affinis* (Baird and Girard) and *Mollienesia latipinna* Le Sueur; one species of tilapia, *Tilapia mossambica* Peters; and one species of catfish, *Ictalurus catus* (Linnæus).

3. Of the species introduced in the Philippines, the carps, giant gourami and black bass, have been found to be of some advantage, particularly in increasing the total fish production of some of the important lakes and rivers. The blue gills and the kissing gourami have prospects of contributing to the productivity of inland waters, but these forms are still under

observation under controlled conditions and their distribution under natural conditions is still limited.

4. Tilapia, plasalid, and the top-minnows or killi-fishes are now regarded in some quarters as pests and less desirable, especially in milkfish ponds. These species compete with milkfish and other indigenous species for food and space and under certain circumstances, prey on the fry and fingerlings of the desirable native species.

5. The methods used in controlling the undesirable exotic species are biological control method, eradication by thorough draining and drying of ponds, control by poisonous substances derived from plants and control by special chemical preparations.

6. Biological control method makes use of the forage-carnivore balance to utilize the excessive quantities of the prolific, small-sized, and stunted fish like tilapia and plasalid, and utilizing some of the native carnivore species such as the ten-pounder tarpon, groupers, sea bass, fresh-water catfish, and mudfish as predators.

7. Control by thorough draining and drying of ponds is the most inexpensive method. This consists of exposing the pond bottom to dry out and kill the predators and the less desirable species of fish.

8. Control by substances derived from plants makes use of the toxic principles of plants used locally as piscicide, of which, there are quite a number.

9. Control by chemical preparations utilize some of the piscicides, insecticides, weedicides, and fungicides which are likewise used for agricultural purposes.

10. A definite appraisal of the effects of fish introduction in the Philippines is premature, considering that the fresh-water forms introduced have not yet been fully established in local situations as to increase the total fish production of the bodies of water where they have been stocked. Some of the species are still under observation in government fishponds and fish culture stations. With regard to the less desirable species, namely, tilapia, mosquito fishes and plasalid, their control and eradication in places where they are harmful to already established fisheries should be intensified. However, studies on their propagation in water areas where they can improve fishing and increase fish production should be continued. The utilization of these species should also be looked into to create

demand and marketability. Any suggestion toward the solution of these local problems will be most welcome.

REFERENCES

ATZ, JAMES. 1954. The peregrinating tilapia. Animal Kingdom Magazine, 57(5): 148–155.

BLANCO, GUILLERMO J., and H.R. MONTALBAN. 1951. A bibliography of Philippine fishes and fisheries. Phil. Jour. Fish. 1(2): 107–130.

CHIMITS, PIERRE. 1955. Tilapia and its culture (A preliminary bibliography). FAO Fisheries Bull. 7(1): 1–33, illus.

HERRE, ALBERT W.C.T. 1924. Distribution of true fresh-water fishes in the Philippines. Labyrinthici, Clariidae, and Siluridae. Phil. Jour. Sci. 24(3): 183–707.

HERRE, ALBERT W.C.T. 1929. An American cyprinodent in the Philippines. Phil. Jour. Sci. 38(1): 121–127.

HERRE, ALBERT W.C.T. 1953. A check-list of Philippine fishes. U.S. Fish & Wildlife Serv. Res. Rep. 20: 1–977. U.S. Govt. Printing Office.

MONTILLA, JOSE R., and JUSTO MONTEMAYOR. 1956. Fishery statistics of the Philippines, 1955. Phil. Bur. Fisheries. 1–61 pp.

PADLAN, PEDRO G., and LUCILA V. HOSILLOS. 1956. A preliminary report on the effects of endrin on fish life in salt water. Unpublished manuscript: Phil. Bur. Fisheries. 1–6 pp.

QUISUMBING, EDUARDO. 1947. Philippine plants used for arrow and fish poisons. Phil. Jour. Sci. 77(2): 127–177.

RABANAL, H.R. 1949. The culture of lab-lab, the natural food of the milkfish or bañgos, *chanos chanos* (Forskål), fry and fingerlings under cultivation. Phil. Dept. of Agri. & Nat. Res. Tech. Bull. 18: 1–7.

RABANAL, H.R., R.S. ESGUERRA, P.G. PADLAN, and E. FAJARDO. 1956. The eradication of undesirable species of fish in impounded bodies of water. Mimeo. Rep.: Phil. Bur. Fisheries. 1–4 pp.

RODRIGUEZ, MAURO G., and JOSE L. MORALES. 1956. Common pests and diseases of rice and their control. Mimeo. Rep.: 1–15. Phil. Bur. Agric. Ext.

ROXAS, HILARIO A., and AGUSTIN F. UMALI. 1937. Fresh-water fish farming in the Philippines. Phil. Jour. Sci. 63(4): 433–468.

ROXAS, HILARIO A., and CLARO MARTIN. 1937. A check-list of Philippine fishes. Common. of Phil. Dept. of Agric. & Commerce Tech. Bull. 6: 1–314.

SEALE, ALVIN. 1917. The mosquito fish, *Gambusia affinis* (Baird and Girard) in the Philippines. Phil. Jour. Sci. 12 (D–1): 177–189.

UMALI, AGUSTIN F. 1953. Plants used in fishing in the Philippines. Proceedings in Ethnobotany, 8th Pac. Sci. Cong. : 309–336.

VILLADOLID, DEOGRACIAS V., H.R. MONTALBAN, G. J. BLANCO, and P. A. ACOSTA. 1955. Fish cultivation in fresh-water units in the Philippines. Phil. Dept. Agric. Nat. Res. Pop. Bull. 45: 1–25.

VILLADOLID, DEOGRACIAS V., and MAMERTO SULIT. 1932. A list of plants used in connection with fishing activities in Laguna de Bay regions and Batangas Province, Luzon. Phil. Agriculturist 21(1): 25–35.

TABLE 1.—*Exotic species of fish introduced in inland waters in the Philippines.*

Species	Date of introduction	Source of stock	Bodies of water where introduced	Remarks
Family Cyprinidæ:				
1. *Cyprinus carpio* Linnaeus (common carp).	1915	Hongkong	Bureau of Science ponds, Manila, Luzon and later distributed.	Naturalized in rivers in Cotabato, Mindanao; Lake Nunungan, Lanao, Mindanao; established in Laguna, Luzon; Bicol Provinces, Luzon; observed in Rio Grande de Mindanao, Mindanao; Lake Paoay, Ilocos Norte, Luzon; Magat River, Nueva Viscaya and Pampanga River, Pampanga, Luzon; Cagayan River, Cagayan, Luzon; Lakes Buhi and Bato, Camarines Sur, Luzon.
2. *C. carpio* (Cantonese common carp).	April 9, 1925	Canton, China	Dulawan, Cotabato.	
3. *C. carpio* (Formosan common carp).	Feb., 1926	Formosa	Lake Nunungan, Lanao, Mindanao; Lakes Buhi and Bato, Camarines Sur Luzon; Laguna de Bay, Laguna, Luzon; Lake Paoay, Ilocos Sur, Luzon.	
4. *C. carpio* (sinjonja variety).	Nov. 1, 1956	Bogor, Indonesia	Central Luzon Demonstration Fish Farm, Tanay, Rizal, Luzon.	Sent by air in oxygen-sealed plastic bags.
5. *C. carpio* (punten variety).	Jan. 10, 1957	do.	do.	Do.
6. *C. carpio* (red variety).	Jan. 10, 1957	do.	do.	Do.
7. *Puntius javanicus* Bleeker (tawes).	Nov. 1, 1956	do.	do.	Do.
8. *Osteochilus hasselti* Cuvier and Valenciennes (nilem).	Jan. 10, 1957	do.	do.	Do.
Family Anabantidæ:				
9. *Trichogaster pectoralis* Herre (snake-skin plasalid).	1938	Bangkok, Thailand	Bureau of Science ponds, Manila, Luzon and later distributed.	Observed generally around Manila, Rizal, Tarlac, Nueva Ecija, Pampanga, Nueva Vizcaya, Luzon; Visayan Islands and Provinces, Visayas, Crater Lake, Cagayan de Sulu Island; some provinces in Mindanao. Also, may have been introduced by natives from Borneo (personal statement of Alvin Seale, April, 1947).
10. *T. trichopterus* Herre (three-spot plasalid).	1938	Bangkok Thailand	Bureau of Science ponds, Manila, Luzon and later distributed.	
11. *T. leeri* Bleeker (pearl plasalid).	do.	do.	do.	
12. *Osphronemus goramy* Lacépéde (giant gourami).	Sept., 1927	Java	Bureau of Science ponds, Manila, Luzon; Laguna de Bay, Laguna, Luzon; Lake Bato, Camarines Sur, Luzon; Tiaong, Quezon, Luzon; Laoag, Ilocos Norte, Luzon; Langangilang, Abra, Luzon; and Ambuklao, Mountain Province, Luzon.	Occurs in more than 25 provinces in the Philippines; naturaized in numerous places, especially in the Bicol Region, Luzon.

13. *Helostoma temminckii* Cuvier and Valenciennes (kissing gourami).	1948 July 7, 1952 Nov. 2, 1956	Bangkok, Thailand Bogor, Indonesia Bogor, Indonesia	Tanay Limnological Station (now Central Luzon Demonstration Fish Farm), Tanay, Rizal, Luzon.	Culture still confined in government stations and some private ponds.
Family Centrarchidæ:				
14. *Micropterus salmoides* (Le Sueur). Black Cass	May 4, 1907	Folsom, California, U. S. A.	Baguio City; Bontoc, Bontoc Subprovince, Trinidad River, Benguet Sub-province, Mountain Province, Luzon.	Abounds in original places stocked; also transplanted to Lake Lanao, Lanao, Mindanao; Los Banos, Laguna, Luzon; Mangatarem, Pangasinan, Luzon; Burnham Park, Baguio City, Luzon; Ambuklao Reservoir, Mountain Province, Luzon.
15. *Lepomis macrochirus* Rafferty (blue gills).	1950	California, U. S. A.	Dagat-dagatan Salt-Water Experiment Station (concrete ponds), Malabon, Rizal, Luzon and later distributed.	Very few survived.
Family Cobitidæ:				
16. *Misgurnus anguillicaudatus* Cantor (loach).	Date unknown, probably between 1920 to 1930.	Japan	Trinidad River, Benguet Sub-province, Mountain Province, Luzon.	Reportedly naturalized in Trinidad River, Benguet Sub-province, Mountain Province, Luzon and in other rivers and creeks in this vicinity.
Family Poeciliidæ:				
17. *Gambusia affinis* (Baird and Girard) (top minnow).	1913	Honolulu, Hawaii (original stock from Seabrook, Texas, U. S. A.).	Bureau of Science ponds, Manila, Luzon and later dispersed.	Found in abundance around Manila Bay, Rizal, Luzon; had been planted in Camarines Sur, Luzon; Zamboanga, Davao and Sulu, Mindanao.
18. *Mollienesia latipinna* (Le Sueur) (top minnow).	1914	Hawaii	Bureau of Science ponds, Manila, Luzon and later dispersed.	Accidentally introduced instead of *G. affinis* which was ordered by Director of Science for mosquito control; abundant in milkfish ponds around Manila Bay, Rizal, Luzon, where it has become a pest and problem in milkfish culture.
Family Cichlidæ:				
19. *Tilapia mossambica* Peters (tilapia).	May, 1950	Bangkok, Thailand	Dagat-dagatan Salt-Water Experiment Station, Malabon, Rizal, Luzon.	Abound in almost all important freshwater lakes, rivers, streams; cultivated in backyard fishponds; occur in rice paddies, brackish water rivers, fishponds; invaded milkfish ponds where it has become undesirable as pest and stiff competitor of cultivated fish for food and space.
Family Ameiuridæ:				
20. *Ictaluridae catus* (Linnaeus) (catfish).	Jan. 10 1935	San Jose, California, U. S. A.	Bureau of Science ponds, Manila, Rizal, Luzon.	Had not reproduced and could have possibly died out.
Family *Cyprinodontidae:*				
21. *Pundalus heteroclitus*	1905	Honolulu, Hawaii	Fresh-and brackish waters around Manila Bay	

TABLE 2.—*Various plants reported with piscicide principles which may be utilized or are being utilized in some localities to control and eradicate undesirable species in the Philippines*[a].

Species	Principle or toxic substance	Preparation and application	Distribution in the Philippines
A. Dioscoreaceæ:			
1. *Dioscorea hispida* Dennst.	Dioscorine, poisonous alkaloid that paralyzes nerves and has narcotic effects.	Fresh tubers crushed or chopped to pieces.	Growth wild, chiefly in thickets and forests at low and medium altitudes.
B. Polygonaceæ:			
2. *Polygonum barbatum* Linn.	Not specific.	Leaves and roots thrown in water.	Common from Northern Luzon to Mindanao in open, usually wet places at low and medium altitudes.
C. Menispermaceæ:			
3. *Anamirta cocculus* (Linn.) W. and A.	Seeds and fruits contain bitter principles picrotoxin, picrotoxinin, and cocullin and two alkaloids—menispermine and paramenispermine. Hydrocyanic acid in leaves, bark, roots, saponin in all parts. Stupefies fish.	Fruits heated and dried then crushed into powder and thrown into lakes or streams to stupefy fish.	Common from Northern Luzon to Mindanao in thickets at low and medium altitudes.
4. *Tinomiscium philippinense* Diels	Picrotoxin in fruits stuns fish.	Ripe fruits roasted until coffee-coloured, pulverized with earthworms cut into size of corn kernel; powdered fruits mixed with small freshwater crabs; mixture scattered in water in early evening.	Endemic in forests at low and medium altitudes in Pangasinan, Tayabas, Laguna, Luzon; Lanao, Davao, Mindanao.
D. Leguminoseæ:			
5. *Albizzia acle* (Blanco) Merr.	Bark contains saponin.	Bark applied in waters.	Endemic in forests of low and medium altitudes from Northern Luzon to Palawan and Negros, Visayas.
6. *A. procera* (Roxb.) Benth.	Saponin in bark, leaves and roots.	Bark applied in waters.	Common in thickets, secondary forests at low altitudes in regions subject to long dry season; reported in Cagayan to Batangas, Luzon, Mindoro, and Busuanga Island.
7. *A. saponaria* (Lour.) Blume	Saponin and hydrocyanic acid in leaves, bark, roots.	Bark applied in waters.	Common in forests, meadows, at low and medium altitudes.
8. *Derris elliptica* (Roxb.) Benth.	Poisonous alkaloid in root sap.	Roots pounded to extract sap to be poured in water or roots thrown in water.	Abundant in thickets along streams, secondary forests at low and medium altitudes from Northern Luzon to Mindanao.

[a] In the preparation of this table; "Philippine Plants Used for Arrow and Fish poisons" by Eduardo Quisumbing was consulted.

9. *D. philippinensis* Merr.	do.	do.	Endemic, reported in Cagayan, Ilocos Norte, Rizal, Mountain Province, Laguna, Bataan, Tayabas, Camarines, Luzon, in thickets and forests at low and medium altitudes.
10. *D. polyantha* Perk.	Poisonous alkaloid with immediate effects.	Roots pounded and scattered in water. Bundle of roots 50 centimeters long and 10 to 15 centimeters in diameter when thoroughly pounded treats a pool 1 meter deep, 10 meters wide; more effective in salt water than in fresh.	Endemic; growing in thickets and secondary forests; reported from Pampanga, Pangasinan, Laguna, Batangas, Luzon.
11. *Entada phaseoloides* (Linn.) Merr.	Saponin in bark and leaves.	Crushed leaves and bark placed in pools, ponds, streams; plant pounded with various ingredients and thrown into the water.	Pantropic; common in forests at low and medium altitudes.
12. *Millettia merrillii* Perk.	Sponin in bark, roots, leaves.	Bark, roots, leaves, pounded and thrown into the water.	Endemic; growing in thickets and secondary forests at low and medium altitudes; reported from Cagayan to Bataan and Rizal, Luzon; Mindoro, Negros, Visayas.
13. *Pithecolobium ellipticeum* (Blume.) Hassk	Saponin or tannim.	Bark pounded and thrown into the water (some localities in Mindanao).	Limited to Palawan, Panay, Negros, Visayas; Mindanao.
14. *Pongamia pinnata* (Linn.) Merr	Bitter alkaloid and acid resin in bark; seeds with bitter taste from resin.	Bark and seeds applied in water.	Common throughout, along seashores and borders of lakes.
E. Erythroxylaceæ:			
15. *Erythroxylum cuneatum* (Wall.) Kurz.	Not specific.	Plant body applied in water (Bulacan).	Reported from Ilocos Norte, Ilocos Sur, Rizal, Bulacan, and Camarines, Luzon; growing in secondary forest on limestone formation at low and medium altitudes.
F. Rutaceæ:			
16. *Zanthoxylum torvum* F. Muell.	Not specific.	Vine pounded thoroughly and inserted in holes to poison eels and mudfish.	Found in Tayabas, Isabela, Luzon; Leyte, Visayas; Mindanao in forest and thickets at low and medium altitudes.
G. Meliaceæ:			
17. *Dysoxylum decandrum* (Blanco) Merr.		Used in Batangas Province.	Common in thickets and forests throughout at low altitudes.
H. Euphorbiaceæ:			
18. *Alchornea parviflora* (Benth.) Muell.–Arg.	Saponin in all parts of plant.	All parts pounded and thrown in water.	Endemic; reported from Bulacan, Rizal, Luzon; Negros, Leyte, Palawan, Visayas; in thickets and secondary forests at low and medium altitudes.

TABLE 2.—*Various plants reported with piscicide principles which may be utilized or are being utilized in some localities to control and eradicate undesirable species in the Philippines.*—Continued

Species	Principle of toxic substance	Preparation and application	Distribution in the Philippines
19. *A. sicca* (Blanco) Merr.	Hydrocyanic acid in leaves; saponin in all parts.	Leaves and fruits applied in waters.	Endemic, reported from Pangasinan, Pampanga, Rizal, Laguna, Manila, Luzon; in thickets along streams at low altitudes.
20. *Croton tiglium* Linn.	Toxalbumin crotin in fruits; universally used for fish poisoning.	Fruits and leaves crushed and applied in slow-running streams and pools.	Common in and about towns, usually planted, sometimes naturalized; introduced from Malaya during prehistoric times.
21. *Euphorbia neriifolia* Linn.	Euphorbon, gum, resin, canotchionic, calcium of malate, etc. in milky sap; used by Igorots as piscicide and one of the commonest fish poisons.	Bark and leaves applied in waters.	Introduced; cultivated in Manila and some large towns; also found in Mountain Province.
22. *E. trigona* Haw.	Euphorbon in milky sap.	Bark is pounded and thrown in water.	Common throughout in thickets and limestone cliffs, usually along sea shores.
23. *Homalanthus fastuosus* (Linden) F. Vill.	Saponin in all parts.	Leaves crushed and placed in streams.	Endemic; common in thickets, old clearings, mostly above altitudes of 720 meters to 2,000 meters; reported from Batan Islands, Abra, Bontoc Benguet, Lepanto, Mountain Province, Nueva Vizcaya, Quezon, Laguna, Rizal, Sorsogon, Luzon; Mindoro; Catanduanes; Panay, Visayas; Lanao, Mindanao.
24. *Jatropha curcas* Linn.	Latex in bark.	Bark pounded and thrown in water; whole leaves and stems poisonous to fish.	Not specified.
I. Buxaceæ:			
25. *Buxus rolfei* Vidal	Not specific.	Fruits dried, finely cut and scattered on water as fish poison.	Endemic; reported from Bataan, Rizal, Pampanga, Quezon, Luzon; Sibuyan, Palawan; Surigao, Mindanao; growing in primary forests at low and medium altitudes.
J. Sapindaceæ:			
26 *Ganophyllum falcatum* Blume	Saponin and resin in bark; saponin in this plant not harmful to human beings.	Bark pounded and placed in water.	Common in dry forests at low and medium altitudes throughtout.

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27. *Harpulla arborea* (Blanco) Radik.	Saponin in bark, leaves, roots.	Bark chopped fine and applied in freshwater streams.	Common in thickets and secondary forests at low and medium altitudes throughout.
28. *Sapindus saponaria.*	Saponin in bark and fruit.	Seeds pounded and bark bruised and thrown into the water.	Pantropic; locally common in secondary forests at low and medium altitudes; reported from Cagayan, Ilocos Norte, Ilocos Sur, Abra, La Union, Pangasinan, Nueva Ecija, Zambales, Pampanga, Bataan, Rizal, Laguna, Luzon; Cotabato, Mindanao.
K. Rhamnaceæ:			
29. *Colubrina asiatica* (Linn.) Brongn.	Not specific.	Fruits applied in waters.	Grows along seashores and borders of tidal streams throughout the Philippines.
L. Sterculiaceæ:			
30. *Kleinhovia hospita* Linn.	Not specific.	Bark and leaves used to poison eels in Marinduque.	Characteristic tree in thickets, secondary growth in forests, deserted clearings throughout the Philippines.
M. Theaceæ:			
31. *Ternstroemia toquian* (Blanco) F. Vill.	Not specific.	Fruits and bark.	Grows in primary forests in most islands and provinces.
N. Guttiferæ:			
32. *Calophyllum inophyllum* Linn.	Saponin and hydrocyanic acid in leaves, bark, roots, poisonous resin.	Leaves, bark, roots, thrown in water.	Characteristic strand tree common along seashores throughout the Philippines.
O. Flacourtiaceæ:			
33. *Pangiom edule* Reinew.	Hydrocyanic acid in fruits; bark with narcotic properties.	Bark applied in waters.	Not specified.
P. Lecythiadaceæ:			
34. *Barringtonia acutangula* (Linn.) Gaertn.	Glucoside, saponin, barringtonin in bark and pulpy fruits stupefy fish.	Bark thrown in water.	Grow in thickets and forests at low and medium altitudes from Northern Luzon to Mindanao, Palawan, most islands and provinces.
35. *B. asiatica* (Linn.) Kurz.	Glucocide barringtonin in seeds and bark, stupefies fish.	Reddish grey bark from mature tree is cut into small pieces comminuted and mixed with earth in small mortar; one part earth to three parts bark; mixture placed in gummy sac and applied at early dawn; fish collected by six o'clock in the morning.	Not specified.
36. *B. racemosa* (Linn.) Blume	Tanin in bark, stupefies fish in 15 minutes.	Bark cut into small pieces pounded and placed in water when it is spongy.	Common throughout the Philippines in most islands, provinces, in thickets, damp places, along seashores streams at low altitudes.

44. *Kibatalia blancoi* (Rolfe) Mers.	Not specific.	Bark, leaves used in fishing.	Endemic; in secondary and primary forests at low and medium altitudes; in Cagayan, Ilocos Sur, Batangas, Laguna, Catanduanes, Luzon; Negros, Guimaras, Leyte, Visayas; Mindoro.
45. *Voacanga globosa* (Blanco) Merr.	Not specific.	Fruits pounded.	Endemic; common in secondary and primary forests at low altitudes, throughout the Philippines.
U. Verbenaceæ:			
46. *Callirpa cana* Linn.	Stunning and killing within one hour.	Leaves pounded with earth until powder-like and juicy; applied five to six o'clock in the morning.	Found in most or all islands and provinces in the Philippines, in thickets, secondary forests at low altitudes.
47. *C. criochlona* Schauer.	do.	Same as *C. cana*.	Common in primary secondary forests at low altitudes, from Cagayan to Sorsogon in Luzon; Mindoro, Leyte, Negros, Visayas; Mindanao.
48. *C. formosana* Ralfe.	Saponin in leaves, bark, roots.	Same as *C. cana*	Common throughout the Philippines in thickets, secondary, primary forests, low medium altitudes.
49. *Viter parviflora* Juss.	Saponin and hydrocyanic acid in leaves, bark, fruits; valuable timber tree commercially known as molave.	Fruits and bark grounded and thrown in water.	Common in all or almost all islands, and provinces in secondary, primary, forests at low altitudes.
V. Rubiaceæ:			
50. *Gardinia curranii* Merr.	Effect within one hour after application.	Ripe fruits are powdered with earth and applied five to six o'clock in the morning; more effective in fresh than in salt water.	Endemic; reported only from Rizal, Bataan, Pangasinan, Batangas, Luzon.

TABLE 2.—*Various plants reported with piscicide principles which may be utilized or are being utilized in some localities to control and eradicate undesirable species in the Philippines.*—Continued

Species	Principle or toxic substance	Preparation and application	Distribution in the Philippines
Q. Araliaceæ:			
37. *Polycias nodosa* (Blume) Seem.	Saponin in leaves.	Leaves crushed and placed in water.	Tree grows in Benguet, Mountain Province, Pangasinan, Zambales, Rizal, Bataan, Laguna, Quezon, Sorsogon, Luzon; Palawan, Leyte, Visayas; Basilan, Mindanao; in second-growth forests at low and medium altitudes.
R. Myrsinaceæ:			
38. *Maesa cumingii* Mez.	Saponin in bark.	Bark applied in water.	Endemic, common in thickets and forests of low and medium altitudes in Abra, Bontoc, Benguet, Pangasinan, Zambales, Nueva Ecija, Bulacan, Rizal, Bataan, Laguna, Quezon, Camarines, Luzon; Mindoro, Palawan, Romblon.
39. *M. denticulata* Mez.	Saponin glucocides.	Whole plant thrown in water.	Endemic in most or all islands and provinces at low and medium altitudes, to 1,200 meters in thickets, secondary forests, openings of primary forests.
40. *M. laxa* Mez.	Narcotic effect stupefies and immediately kills.	Fruits applied in waters.	Endemic, common in secondary and also often in primary forests at low and medium altitudes throu[illegible] the Philippines.
S. Ebenaceæ:			
41. *Diospyras ebenaster* Petz.	Narcotic effect stupefies and immediately kills.	Unripe fruits pounded and thrown in water.	Introduced from Mexico; planted in and about t[illegible] namental, foliage, edi[illegible] shades; spontaneou[illegible] Nueva Ecija, Bata[illegible] and other provinc[illegible]
42. *D. multiflora* Blanco	Tannic acid in fruit, juice.	Fruits collected when showing indication of opening, pound and mixed with oil and applied by about six o'clock; more effective in fresh than in salt water.	Not specified
T. Apocynaceæ:			
43. *Cerbera manghas* Linn.	Not specific.	Seeds applied in fishing.	Not specified.

19.

TABLE 2.—V.

8. 2, 4-D (emulsifiable concentrate).	Active ingredients: Isopropyl ester of 2, 4-dichlorophynoxy acetic acid, 44%. Inert ingredients: 56%. Acid.	Kills broad-leaf weeds, water weeds in irrigation canals and lowland rice; no effects on rice and grass like crops but weeds that have absorbed plants are impaired in metabolic process and die.	Concentrate emulsified with equal amount of water and solution sprayed; may be broadcast using sawdust, rice, ash or fertilizer as carrier.
9. Bladex F (emulsifiable concentrated insecticide).	Active ingredients: Tetraethyl pyrophosphate, 20%. Other related organic phosphates: 30%. Inert ingredients: 50%.	Control of rice bugs, aphids, mites, red spider, mealy bugs and some soft-bodied insects; kills by direct penetration of skin, paralyzes muscles and nervous system and stops respiration.	Diluted with water and sprayed.
10. Aldrex 2 (emulsible insecticide).	Active ingredients: Hexachloro-hexahydro demethano naphthalene, 23.10% petroleum hydrocarbons, 52.03%. Related compounds, 17.37%. Inert ingredients: 7.50%.	Control of locusts, white grubs, leaf miners, abaca stock weevils, plant bugs, ants, and soil insects.	Emulsified with water by proper agitation and sprayed.
11. Copper fungicide (free flowing fungicidal powder based on copper sulfate).	Tribasic copper sulfate	Prevention of fungus growth on plants.	Mixed with water to form paste and diluted with water and other necessary chemicals; applied before fungus attacks plants.
12. Lime sulphur (liquid agricultural fungicide and insecticide).	Calcium polysulfide.	Kills mites, red spider, effective against scale on citrus, mangoes, coconut, star apples, and chicos.	Diluted with water and sprayed before onset of disease.
13. Snail killer (crystalline powder concentrate of metaldehyde).		Effective against giant African snails, related snails and slugs.	Mixed with baiting materials such as rice-bran, corn-meal, copra meal and placed where snails and slugs are found.
14. Rat killer (rat poison of anti-coagulant type containing 0.5% Warfarin	Warfarin: [3-(a-acetonylbenzyl) 4-hydroxycoumarin 0.5%. Inert ingredients, 99.5%.	Control and eradication of rats.	Mixed with bait and applied in places frequented by rats and protected from weather elements.
15. D.D.T. (wettable 50% and 75% D.D.T. soluble in water, and Technical 100% D.D.T. soluble in kerosene).	Dichloro-diphenyl-trichloroethane.	Control tomato, cabbage, tobacco, rice army worms, leaf hoppers, psyllids, corn borers, caterpillar, other chewing insects, bag worms, gypsy moth, horn flies, lice, ticks, and mosquitoes.	Dissolved in water and sprayed when pests appear.
16. Gesarole 25 (emulsifiable solution, insecticide).	Active ingredients: Dichloro diphenyl trichloroethane, 25%; xylene, 63%; petroleum derivatives, 7%. Inert ingredients: 5%.	Controls leaf hopper, tip borer, twig borer, bugs, army worms, ant worms, stem borers, leaf worms, bud worms, aphids, ants, beetle, thrips, psyllid, slug caterpillar, rindborer, green-bug, barkborer, 28-spotted beetle, stalk-borer, locust.	Dissolved in water, stir and spray.

TABLE 3.—*Various chemical preparations for agricultural purposes obtained locally, that have been observed to have some effects on fish life and may be tested for use in the control and eradication of undesirable species.*

Chemical preparation	Chemical composition	Use and effects	Application
1. Dieldrin 50% W.P. (Water dispersible powder).	Active ingredients: Hexachloroepoxy-octahydro dimethano napthalene, 42.5%. Related compounds 7.5%. Inert ingredients: 50%.	Controls abaca, corn, weevils root grubs, male crickets, houseflies, termites, cockroaches, onion thrips, leaf beetles and garden ants.	Powder prepared as paste and dissolved in water to be sprayed, or applied dried with proper dust carrier or fertilizer.
2. Aldrin 40% W.P. (Water dispersible powder).	Active ingredients: hexachloro-hexahydro dimethano naphthalene, 38%. Related compounds: 6.4%. Inert ingredients 55.6%.	Controls grasshoppers and locust, abaca, corn weevils, root grubs, onion thrips, stink bugs, leaf miner.	Do.
3. Endrin 19.5% E.C. (emulsible concentrate).	Active ingredients: Indoendo isomer of hexa-chroloroepoxy-octahydro dimethano naphthalene, 19.5%; hydrocarbon solvents, 70.5%. Inert ingredients, 10.0%.	Controls rice stem borers, aphids, mango-leaf hopper, mealy bugs, rice army worms, tobacco bud worms, cabbage worms and caterpillars. (1 p.p.m. concentration effected total kill of tilapia ranging from 24–84 mm. total length within 10 hours in salt water.)	Mixed with water and sprayed on pests or crops.
4. Resitox D–25 M (emulsifiable oil).	Active ingredients: DDT, 25%; petroleum, 70%. Inert ingredients: 5%.	Controls army worms, residual spray for thrash piles hog pens, barns, dung, etc. livestock spray for hogs, goats, etc.; action depends on DDT which kills insects by paralyzing nerves.	Mixed with water and shaken until emulsified and sprayed immediately.
5. Mendol soluble oil. (Highly refined emulsifiable oil).	Active ingredients: Petroleum oil, 98.5%. Inert ingredients: 1.5%.	Control insects and their eggs.	Diluted and sprayed; or as spreader for lead arsenate and copper fungicide.
6. Lead arsenate.	Lead arsenate	Control chewing insects and tobacco leaf worms; deadly to all plant and animal tissues in soluble form.	Mixed with diluent and applied as insecticidal dust or mixed with water and applied as agricultural spray.
7. Dieldrex 15 (emulsible insecticide).	Active ingredients: Hexachloro-epoxy octahydro dimethano naphthalene, 15.83%; petroleum hydro-carbons, 73.38%. Related compounds; 2.79%. Inert ingredients, 8%.	Control of insects, residual spray against flies, mosquito larvae; external parasites of livestock, locusts, pests of fibre plants, soil insects. Kills insects as nerve or stomach poison.	Mixed with water and agitated until milky emulsion is formed and sprayed.

RESEARCH ACTIVITIES ON MARINE FISHERIES BIOLOGY IN 1957 [1]

By Klaus Tiews
FAO/ETA Fishery Biologist

1. INTRODUCTION

This interim report covers the first year of assignment of the writer, that is, from 16 October 1956 to 30 September 1957.

The writer's technical instructions were: "to assist the Government in the planning of a programme of research in marine fishery biology and to give training to Philippine workers who are to carry out this research; to make use of the Government's programme of research on the tunas as a means of demonstrating techniques to be employed and to assist in planning and organizing research work on the tunas".

He was further instructed to co-operate closely with Mr. Tatsuzu Susuki, FAO Master-fisherman (Fishery Engineer), who is assigned in the Philippines to demonstrate tuna long line fishing and other advanced fishing methods, in the development of the research work on tunas.

Chapter II describes the situation existing at the beginning of this period.

Chapter III deals with the research work initiated and systematically carried out under the supervision of the writer. As all such work is scheduled to last for a period of at least one year, the definite research results will be published in the Final Report to the Government and in scientific journals.

The plans of work for the second year of assignment, and budgetary recommendations, are given in chapter IV.

The opportunity is taken here to record the effective role played by the Director of the Bureau of Fisheries, Mr. Montalban, the Chief of the Fisheries Research Division, Mr. Martin,

[1] Interim Report to the Government of the Philippines by the author who is a member of the staff of the Institut fur Kusten-und Binnenfischerei der Bundesforschungsanstalt fur Fischerei, Hamburg detailed as Marine Biologist by F.A.O. under the Expanded Technical Assistance Program. The report was coursed through F.A.O. Headquarters which issued the paper in Rome in December, 1957 as Document No. FAO/58/1/130 entitled "Interim Report to the Government of the Philippines on Research on Marine Fishery Resources."

Chemical preparation	Chemical composition	Use and effects	Application
17. Gy-Cop "53" (metallic copper)		Controls onion, potato, tomato blight, downy mildew, leafspot, anthoracnose, scab, canker, citrus diseases.	Dissolved in water and solution sprayed or as dust by adding talc or any light carrier.
18. Acrosals.	Pyrethrins, 1%; sesame oil in Freon, 2%.	Controls mosquito and fly adults.	Applied in swaths at 20 ft. or 7 pace interval on the ground.
19. Paris Green.	Copper aceto-arsenite containing 50% plus of arsenious oxide.	Controls mosquito larvae.	Diluted with inert dust such as fine sand, hydrated lime, etc., and applied by hand or power dusting in rivers, lakes, pools, swamps.
20. Petroleum oil.	Light fuel oil of No. 2 grade or "Bunker C" diluted 1/3 with kerosene.	Controls mosquito larvae.	Applied by spray, drip can, and other methods on dense aquatic vegetation.

University will increase its efforts in marine research, more closely related to fisheries, since the transfer to it in January 1957 of the Philippine Institute of Fisheries Technology and its technical staff, formerly under the Bureau of Fisheries.

2.12 *Research Ships*

During 1956/57 the Bureau of Fisheries had one research vessel, the "M/V David Starr Jordan", in running condition. The boat was acquired in May 1950 as part of the equipment and supplies turned over to the Philippines by the Government of U.S.A. at the termination of the Philippine Fishery Programme of the United States Fish and Wildlife Service. The boat is 16.2 m. overall, 14.6 m. at the water line, 4.0 m. in beam and 2.0 m. in draft. The 30-ton vessel is driven by a 135-horse power Murphy diesel engine, giving a cruising speed of 6 to 7 knots. It is equipped with different kinds of echo recorders and fish finders and with a hydrographic winch which can pay out the 5/32-inch hydrographic wire at the rate of 2 in/sec. and haul in at about 1 to 6 m/sec.

Unfortunately, the wire has become rusted and must be replaced to avoid the loss of the valuable hydrographic sampling equipment. Several hundred meters of the wire, which originally measured some 2,000 m., had to be cut off because of its bad condition.

Although the boat is stable, seaworthy and highly maneuverable, it is too small to carry out systematic research in the high seas. It is suitable only for research in bays and other coastal waters.

A smaller "J" boat is still under repair, but will be ready in the next few months. The boat is 11.9 m. overall and 2.7 m. beam. It will be equipped with a 120 h.p. Diesel. This boat also is suitable for coastal fisheries research.

Since these boats are operated by the Division of Marine Fisheries and are not always available to the Division of Fisheries Research, which has continuous sampling programmes, a third boat for the sole use of the Division was purchased in September 1957, at the recommendation of the writer, with the Project Development Funds of the Technical Assistance Programme 1957–58. It cost only 1,500 pesos. The boat is a stable banca 11 m. overall and 1 m. beam. The sides of the banca were raised by 50 cm.

in supporting and implementing the plans for development of the research services; their interest in the work and their efforts in solving the problems have been unfailing. The expert also records the enthusiasm and untiring efforts of colleagues and friends in the Bureau of Fisheries, Philippine Institute of Fisheries Technology and the National Museum, especially Mr. Umali, Mr. Ronquillo, Mr. Rasalan and Mrs. P. Borja. Members of the Interisland Deep-Sea Fishing Association, especially Mr. I. Lachenal, President of the Association, cooperated in the work.

Valuable help was received from the National Research Council, FAO Headquarters and the Technical Assistance Board in Manila. Mr. Eric Ward, United Nations Technical Assistance Resident Representative in the Philippines, displayed great interest in this work and gave invaluable help.

2. EXISTING SITUATION

2.1 *Existing organization and facilities of research*

2.11 *Organization*

Research in marine fishery biology is carried out for the Bureau of Fisheries by the Division of Fisheries Research (formerly the Division of Fisheries Technology) headed by Mr. Claro Martin. This is one of the five divisions of the Bureau. The others are:

(1) Administrative Services
(2) Marine Fisheries
(3) Inland Fisheries
(4) Licenses and Regulations.

The Division of Fisheries Research is subdivided into the following sections:

(1) Hydrology and Fisheries Biology
(2) Technological Research
(3) Fisheries Economics and Statistics,

of which the Hydrology and Fisheries Biology Section, headed by Mr. I.A. Ronquillo, is responsible for research on marine resources.

The marine biological research that is occasionally carried out by the Departments of Zoology and Botany of the University of the Philippines is mainly taxonomic relating to all kinds of marine life. It is possible that the

There is a general lack of essential equipment in the biological and the hydrographic laboratories of the Dagatdagatan Experimental Station. The equipment in use was acquired at the termination of the U.S. Philippine Fishery Programme in 1950. Since then no new equipment has been purchased. The hydrographic laboratory was well-equipped with Nansen bottles and reversible thermometers. Ten Nansen bottles and 12 reversible protected thermometers were still in good working condition. The stock of glassware (pipettes, burettes, chlorinity bottles, oxygen bottles, etc.) and of chemicals has proved insufficient.

The equipment of the biological laboratory consisted only of two binocular microscopes, one compound microscope, two triple beam balances, one torsion balance, dissecting instruments and dissecting pans for two workers and one calculating machine. It was possible, through the joint efforts of the Bureau of Fisheries, the PIFT, the National Research Council, the National Economic Council, the FAO Headquarters and the Resident Representative of UNTAB, to acquire the following equipment:

5 binocular microscopes
1 compound microscope
5 calculating machines
8 balances
7 dissecting sets
16 dissecting pans
4 slide rules
2 Hensen egg nets
2 smaller plankton nets
1 ring trawl
1 bottom grab
2 thermometers
12 messengers for Nansen bottles
3 baby trawls

Larger quantities of tin cans, preserving jars, chemicals, preserving fluids and other supplies were purchased continuously. A deep freezer, bought for the Technological Research Section, is partially available to store samples of fresh research specimens, but not large enough to fully satisfy the needs.

Although there has been important progress in assembling research facilities during the last year, the equipment

and the width increased by 70 cm. The boat is built as a basnigan with two outriggers and is equipped with a 25 h.p. Continental gasoline engine. It represents the ideal seaworthy type of small boat for coastal research. It is now being used in the baby trawl operation of the newly-initiated research program in marine fishery biology.

Two more boats of 100 and 250 tons gross respectively, urgently needed for offshore research, are expected from Japan through the War Reparations Commission. Their measurements and equipment are not yet known to the writer.

2.13 *Research laboratories and their equipment.*

The previous research laboratories of the Bureau of Fisheries were transferred in 1952 from the main office of the Bureau of Fisheries and from the Philippine Institute of Fisheries Technology, to the Dagatdagatan Salt-water Fishery Experimental Station. This station was established in 1936 for fishpond experiments. It is situated on an island in a lagoon in the Malabon river, in the suburbs of Manila, some 12 km. from the Central Office of the Bureau. It consists of a pond area of 11 hectares and 7 wooden one-story buildings which house offices and storerooms, two large biological laboratories, one small hydrographic laboratory, one large chemical laboratory, one small bacteriological laboratory, one large pilot canning plant and one large fish culture laboratory. An eighth building, with an oceanographic and physiological laboratory, is nearly completed, and is to be equipped with aquaria and an air conditioner. All laboratories have fresh water supply, electric current and telephones, but are without air conditioning and are rather hot during the summer.

The isolated position of the station may give a quiet research atmosphere, but has the disadvantage of inaccessibility, not only for the research staff, but also for the transport of materials. A small pier for the transport boats and a permament foot bridge to replace the wooden bamboo bridge, which spans the Malabon river, would improve matters.

A smaller limnological laboratory exists in the Tanay Limnological Station.

The names of the permanent employees of the Bureau of Fisheries participating in the training programme are given in Appendix 5.3.

The expert selected the trainees from a large staff of emergency employees of the Bureau of Fisheries assigned to him. There were incidental lay-offs because of insufficient funds, and only those assistants who volunteered to work even without pay could be retained. The readiness to work without pay characterizes the enthusiasm and idealism of the young research team finally selected. The 23 emergency employees were selected from a group of 36 who worked temporarily under the Project.

The main problem which faced the expert was the lack of adequate funds. Although officials of the Bureau of Fisheries did their utmost to secure these, nearly every month the emergency employees had to be laid off, sometimes for several weeks. In July 1957, after the new fiscal year 1957–58 had started, the situation became still worse as funds provided in the new budget of the Bureau were inadequate and available funds were still smaller. The only possibility for continuing the then well-established research programme was to approach the Resident Representative of the UNTAB, Mr. Eric Ward, for money which was to have gone into a project in marine fishery biology of the Bureau of Fisheries. This project, which had been rejected, called for $10,966 of FY 1957 technical cooperation funds (ICA) and ₱88,600 of counterpart funds (NEC). The Director of Fisheries requested, therefore, the utilization of ₱76,700 from the Project Development Funds of the Technical Assistance Programme 1957–58, in connection with the expert's project. Although the request is still under consideration with the NEC, Mr. Ward has been able, since August 1957, to make an advance to enable the Bureau to pay the salaries of all emergency employees and to purchase essential equipment and supplies. These salary payments have been made on the condition that corresponding amounts are included in the budget of the Bureau of Fisheries for the fiscal year 1958–59.

It cannot be stressed enough that the continuation in service of the very promising researchers now training under the writer is essential to the proper development

is still inadequate, lacking all kinds of sampling gears such as bottom egg nets, dredges, standard plankton nets, etc. There is a high "loss risk" in the use at sea of equipment such as sampling gear, and nets especially have a relatively short span of life—about one or two years. Funds available to the station must be sufficient to permit maintenance of supplies so that there should be no interruption in research efforts.

A final list of equipment needed will be prepared after the decision on requests for assistance from the Colombo Plan, the ICA, the NEC and the National Science Board of the Philippines. The expert spent much of his time in assisting the Bureau of Fisheries to prepare these requests upon which so much research activity depends.

2.14 *Research staff.*

When the expert arrived in the Philippines, the Director of Fisheries promptly assigned counterpart assistants to work with him. These were mostly graduates of the PIFT, but lacked the training and background needed for independent research work. The expert requested the help of the Department of Zoology of the U.P. in arousing interest among young B.S. graduates in Zoology in the promising field of marine research; as a result six graduates joined his training team not long after and worked on their thesis for the M.S. degree under his supervision. Another group of B.S. graduates joined the team from the U.S.T.

To date, 45 counterpart assistants are under training, 22 being permanent employees of the Bureau of Fisheries, and 23 emergency employees. Twenty-five are female and 20 are male.

Counterpart assistants continuously under training have been:

18 since October 1956—ca. 12 months
1 since November 1956—ca. 11 months
3 since December 1956—ca. 10 months
6 since January 1957—ca. 9 months
5 since February 1957—ca. 8 months
4 since March 1957—ca. 7 months
3 since April 1957—ca. 6 months
2 since June 1957—ca. 4 months
2 since July 1957—ca. 3 months
1 since August 1957—ca. 2 months

"R.S.S. Dana II" (1929), the Dutch steamer vessel "H.M.S. Willebrord Snellius" (1930), the American warship "Cape Johnson" (1945), and the Danish Navy Corvette "Galathea" (1951). However, the first applied oceanography investigations of value for commercial fisheries were carried out from 1947 to 1950 by the Philippine Fishery Programme of the United States Fish and Wildlife Service. During this period an intensive exploration of Philippine and adjacent seas was made by the "U.S.M/V. Spencer F. Baird". More than 1,100 oceanographic stations were established over an area of more than 800,000 sq. mi. The data collected are still being compiled and analyzed in the United States.

After the termination of the Philippine Fishery Programme in 1950, the Bureau of Fisheries continued oceanographic research in the principal fishing areas, such as Manila Bay and Lingayen Gulf. The operation had to be discontinued in 1955 for a general overhaul of the research vessel "M/V David Starr Jordan". Because of lack of funds, this delay lasted until 1957.

Although fisheries research in the Philippines, especially from 1947–54, indicates a modern approach to fishery problems through systematic scientific studies, little attention has been paid to real marine fishery biological research. Special research has only occasionally been undertaken, to describe the several larval forms of marine fish, to determine the racial status, spawning and feeding habits of tuna. the taxonomy and feeding habits of *Rastrelliger* sp. The lack of a well-balanced fisheries research programme minimized the usefulness of the oceanographic surveys in coastal areas intended to contribute to the explanation of fishery phenomena.

The activities of the Bureau of Fisheries in marine fisheries biological research are hardly significant compared with its other activities. Greater endeavours have been made, for instance, in the fields of fresh-and brackish-water fisheries biology, aquiculture, fish processing and especially in fisheries technology.

The lack of knowledge of the biology and life history of the important marine food fishes, of their behaviour, distribution and migration, etc., became more obvious in recent years when controversies arose among different

of marine fisheries biological research work in the Philippines, one of the primary tasks of the Bureau of Fisheries. This was fully recognized by UNTAB and the National Economic Council, when both agreed to the payment of trainees to guarantee their continuous service until July 1958.

2.15 *Library facilities*

A good scientific library is essential to keep the researcher up to date with the methods being applied in his field and with results in other countries. Lack of library facilities tends to isolate workers and can easily lead to failures and to a waste of effort and money.

Together with the PIFT, the largest part of the library of the Bureau of Fisheries was transferred to the University of the Philippines in January 1957. This library, however, contained very few of the important periodicals in the field of fishery biology.

To-day, by the joint efforts of the Bureau of Fisheries and the writer, the library of the Bureau of Fisheries receives 100 new periodicals on fishery biology and technology from 30 countries in exchange for "The Philippine Journal of Fisheries" and the "Bulletin of the Fisheries Society of the Philippines". The replies to a further 150 exchange proposals are still awaited.

2.2 *History of research in the Philippines*

The first marine research in the Philippines dates back 160 years, and since then the main efforts of researchers of many nations have been directed to identifying the very rich fauna of the archipelago. Albert W. Herre, in his Check List of Philippine Fishes (*Research Report* No. 20, U.S. Fish and Wildlife Service, 1953), records no less than 2,277 fish species grouped in 205 families and 716 genera.

Oceanographic research by deep-sea expeditions in the Philippine Archipelago has contributed greatly to knowledge of the area. Most noteworthy are the British "H.M.S. Erebus and Terror" (1839–43), the Spanish Frigate "Navarra" (1857–58), the British "H.M.S. Challenger" (1872–76), the U.S. Fisheries steamer "Albatross" (1907–1909), the German survey vessel "Planet" (1907–1912), the German cruiser "Emden" (1927), the Danish steamer

groups of fishermen regarding depletion of the resources and extension of the fisheries.

It must be stressed here that the necessity of intensive marine fisheries biological research has been recognized by the Department of Agriculture and Natural Resources, and by the Director of Fisheries and his technical staff. While, for example, every northern European country can participate in the research results of neighbouring countries, the Philippines, because of its location in an area poor in marine fisheries biological services, can profit only indirectly from the results of fisheries science research published elsewhere.

3. WORK DONE

3.1 *Research and training programme*

3.11 *The planned research programme*

Together with the technicians of the Bureau of Fisheries the writer outlined a research and training programme in marine fisheries biology to meet the needs of the country. The programme was made as comprehensive as possible so that the Philippine workers could continue the research and develop new research programmes after the departure of the writer. It was agreed upon by the Director of Fisheries and by Mr. Martin.

All research was scheduled for a period of at least one year. Some work will have to be continued over a period of several years, if yearly fluctuations in the landings and consequently in fish stocks are to be observed to establish definite relationship between the yield in certain fisheries on one hand, and the fishing intensity and the dynamics of fish stocks on the other.

This has now developed into a well-balanced extensive research programme. It covers life history studies of demersal and pelagic fish of economic importance (slip-mouth, threadfin bream, lizard fish, shrimps, anchovies, roundscad, chub mackerel and others), studies on their taxonomy, distribution, population dynamics and exploitation, research in hydrography, plankton and benthos, field work aboard commercial fishing boats and research boats, and compilation and interpretation of data.

This information will serve as basis for governmental policy on the fishery resources with respect to:

(1) Proper management and conservation, including decisions on conflicts arising from their utilization.

(2) Speedy and orderly development of fisheries to increase fish production.

(3) Improving the profitableness of commercial fishing operations which may then lead to the development of new fisheries.

The research initiated during the first year of assignment is as follows:

(*a*) pelagic (free swimming) species;

(*b*) demersal (bottom) species;

(*c*) distribution of some fish and crustacean species at different depths;

(*d*) other oceanographic research, such as hydrography, plankton and benthos.

Research under (*a*) and (*b*) consists mainly of life history studies of important commercial fish species to provide basic knowledge on the sexuality, maturity, fertilization, fecundity, spawning seasons, frequency of spawning, spawning grounds, egg structure, longevity, hardiness, competitors, predators, parasites, diseases, nutrition and growth, migration, schooling habits, reproductive habits of those species, and also on the structure, size, density, natality, mortality and growth of the fish population and their distribution.

The taxonomy of nearly all fish genera was rechecked by systematic research, so as to distinguish exactly the different species.

Research under (*c*) and partially under (*b*) has been initiated with regard to the otter trawl controversy in Philippine waters and under (*d*) in connection with (*a*), (*b*) and (*c*), to obtain basic information on the productivity of the Philippine waters.

The research programme is being undertaken mainly in Manila Bay, which is one of the most important fishing centres and the closest to the laboratories. The studies will serve as the basis for a monograph on a typical Philippine Bay. In some cases the research has been extended to other areas.

3.12 *Training of Philippine workers and their assignment*

The writer spent appreciable time during the first year in training workers in the research detailed above. Advice was given by practical demonstrations. As marine fisheries biological research depends considerably upon a suitable staff of sea-going men, male counterpart assistants were trained as far as possible aboard commercial fishing boats or on research boats. Not all proved suitable for work aboard, and some still have to become accustomed to hard conditions. Every male counterpart spent 26 days aboard in connection with the 61 field trips, which comprised some 155 days. Some spent more than 70 days at sea.

Besides the practical training in connection with research, a weekly seminar was started in January. Reports on scientific important researches in the world were distributed to trainees for later discussion.

The aim was not only to train them in exact reading of literature, in oral reports and in discussion, but also to impart a broader knowledge of literature. Short lectures were included in connection with the reports and 32 seminars took place in an improvised lecture hall, during which 46 reports were issued and discussed. This kind of training seems to be highly profitable to the young research team, and the writer would like to express his hope that it remains a permanent institution.

The writer assigned his trainees from the very beginning to practical research work. Trainees within one team were requested to interchange their responsibilities. Newcomers can now be initiated in their tasks by their fellow team workers and in trained minor research by the more advanced trainees.

The overall programming and administration was the responsibility of Mr. Ronquillo, assisted by Mrs. Borja, Mr. Llorca, and Mr. Datingaling.

A list of trainees and their assignments is given in appendix 5.4.

3.2 *Research on tuna and other pelagic fish species*

3.21 *Tuna*

When the writer arrived in the Philippines in October 1956 he checked the facilities for tuna research. He found

that equipping of the "M/V David Starr Jordan" for tuna longline fishing had been delayed by several months, and the first trip did not take place until February 1957. Only 2 m.^{2} working space was available on board for the scientific staff because it was necessary to increase the number of the crew members from six to about 20 in order to handle the long-lines.

It was evident that this vessel was too small to develop a tuna research programme and that it would be impossible to use for demonstrating the methods applied in marine fisheries biological research. Indeed, in May 1957 the Director of Fisheries, being afraid the small boat would capsize, prohibited its use after the second trip.

In April 1957 one of the counterparts returned from tuna trap observations at Paluan Bay, Mindoro, and reported that the selling of tunas had been prohibited because of cases of tuna poisoning. Thus, as fishing stopped, the last basis for tuna research was lost.

Should the large research vessels from Japan arrive during the writer's second year of assignment, he will make up for time lost.

On the occasion of the visit of the Japanese research vessel S.S. "Shunkotsu-Maru", the expert participated in a short demonstration trip of tuna longline fishing in waters north of Lubang Island, 1–3 February 1957, to give three of his counterpart assistants training in the biological and hydrographic investigations on tuna. From 6–17 February and from 23 March–12 April, 1957, two of his counterparts joined the two tuna long-line operations aboard the "M/V David Starr Jordan" to Mindoro Strait and West Panay, initiated by Mr. Suzuki, to make scientific observations. The trips were limited to nine catch operations because of bad weather. The 13 tuna caught were checked with regard to length, weight, number of finrays, finlets, stomach content, sex, maturity stage, etc., but unfortunately there were too few fish to yield any new data on the biology and distribution of tuna in Philippine waters. The hydrographical data collected during these trips was also insignificant.

Many length-measurements of tuna were collected by another counterpart who was assigned in Paluan Bay, Min-

doro, from 18 December 1956 to 15 February 1957, and from 23 March to 6 April 1957, to observe the catch composition of the local trap net fishing. But this work was stopped, because of tuna poisoning.

3.22 *Anchovy or dilis* (*Stolephorus* sp.)

The anchovy ranks third in importance among commercial fish resources; its fishery is carried out with boats over three tons gross. These boats are under the supervision of the government, while the smaller boats are under the jurisdiction of the municipal authorities. The annual catch of 5,000 metric tons (1956) constitutes 4.7 percent of the total production of the Philippine fisheries.

A research programme was started in November 1956 on the five or six species of the economically important genus *Stolephorus*. The cost of securing anchovy samples is relatively low, which is an advantage. Research was concentrated on the possibility of increasing production without risking depletion of the stock.

Observations on the species, length, weight, sex, maturity, length and weight of gonads, and abundance of parasites, were made on specimens taken every other week for five consecutive days from the Malate fish market, and coming from known localities.

Special racial studies were initiated to determine whether the stock of anchovies in the area being fished draws recruits from other areas, and if so the magnitude of the exchange of individuals between areas. A team of eight workers is engaged in this research. Three are doing life-history research, two are making racial and taxonomic studies, and three are engaged on the statistical compilation of the data.

The attached "Chart of Monthly Progress of the Project" (Appendix 5.1) shows that during the period under review, 172 samples were taken, 65,620 specimens were determined and measured, and of these 33,340 specimens were studied in detail. Since April, 136 specimens have been studied for stomach content.

Up to March, samples were collected only from the Manila Bay and from Lucena. Since then, sampling has been occasionally extended to other catching areas, such as Batangas Bay, Lingayen Gulf, San Miguel Bay and

Iloilo. Twenty-two samples were collected, 17,133 specimens were determined and measured, and 3,360 specimens were studied in detail.

With regard to the taxonomic and racial studies, 17 samples of 1,460 specimens of *Stolephorus zollingeri, S. heterolobus, S. tri, S. commersonii, S. indicus* and of a newly discovered species, were checked as to the numbers of gillrakers on the epi-, cerato-and hypobranchial of the gill arch; of scutes; of finrays of the dorsal, anal, caudal, pectoral and ventral; of vertebrae and to the total-, fork- and standard lengths.

3.23 *Roundscad or galongong* (*Decapterus* sp.)

The roundscad is one of the very few fish in Philippine waters caught in large quantities most of the year. A special bag net fishery developed after the war in Palawan waters, Batangas, Balayan, Tayabas and Pangasinan Bays, in San Miguel Bay, Ragay Gulf, and northern Zamboanga. Some 18,880 metric tons were landed in 1956. The fish is the most important of commercial species, the catch amounting to 17.7 per cent of total landings. The scads are small to moderate-sized, with a taste and texture of flesh similar to that of chub mackerel.

The writer considers that this fishery should be further developed; although not "first-class", the fish is popular with poor people because it is cheap and of good flavour. This fishery may prove to be the most important in supplying cheap protein food to the mass of the Filipino public.

Some of the preliminary results of the research provide an excellent example of the usefulness of such research in the development of fisheries in general. Food investigations proved that roundscad occasionally feeds on small bivalves which live on the bottom; thus, this otherwise pelagic fish, which during dark nights is attracted by strong light and caught on the surface in bag nets, must spend some time on the bottom, probably in daytime, even if only occasionally. The question then arises as to whether it is possible to catch roundscad consistently at the bottom by otter trawl, as in the case of the European herring fishery. The answer seems to be that probably it could be since it is occasionally found in quantities of some 60–100 specimens in the otter trawl catches outside

Manila Bay. Experimental fishing with light otter trawls similar to the European herring net could prove whether a new day fishery on roundscads could be established. If successful, this could prove to be of great importance because the existing bag net fishery can operate only during dark moonlight nights, that is, only a fortnight of every month.

The attached "Chart of Monthly Progress of the Project" (Appendix 5.1) shows that since November 1956, 43 samples of *Decapterus* sp. from Palawan waters and other areas were collected on the Navotas and Malate fish markets; 32,535 specimens were determined and measured, and 15,640 specimens were examined in detail; and 236 fat analyses are being made to determine the yearly cycle of fat content of a typical tropical fish. Since May 1957, 221 analyses of stomach content have been carried out.

In the taxonomic studies, 463 specimens of 21 samples were checked with regard to the number of gillrakers of the epi-, cerato-and hypobranchial of the gill arch; of scutes and scales in the lateral line; of the finrays of the first and second dorsal fins, of the caudal, anal, pectoral and ventral fins; of vertebrae.

Three counterpart assistants are assigned to the biological research, two to the taxonomic research and one to the statistical compilation of data.

3.24 *Chub mackerel or hasa-hasa and alumahan* (*Rastrelliger* sp.)

The chub mackerel ranks 13th in the commercial fish landings with a total catch of 2,200 tons in 1956, or 2.1 percent of the total production. The mackerel are of moderate to large size, with excellent flesh. Research work was initiated in December to continue work of the Bureau of Fisheries over the last few years. *Rastrelliger* research is strongly recommended by the Indo-Pacific Fisheries Council and a Regional Technical Assistance Programme may be initiated on the recommendation of the Council. The high price which the fish demands presents a handicap in carrying out a sampling programme.

Since December 1956, 91 samples of 5,990 specimens of *Rastrelliger* sp. have been collected and preserved. From these, 2,470 specimens have been examined. In August

1957, the programme was extended to measurements made in the Malate market. Some 1,800 length-measurements were taken in August and September (compare Chart of Monthly Progress of the Project, Pos. Nos. 17–24; Appendix 5.1).

Some 634 specimens of *Rastrelliger* sp. were investigated with regard to the number of gillrakers of the epi-; cerato-, and hypobranchial of the gill arch; of finrays of the first and second dorsal fins, of the pectoral, ventral, anal and caudal fins; of the dorsal and ventral finlets; of the vertebrae; to the total-, fork- and standard length; to the body depth, head length, height of the first dorsal and pectoral fins.

The research staff consists of three workers.

3.3 *Research on demersal (bottom) fish species and shrimps (Commercial Otter Trawl Operation)*

The otter trawl fishery is most important commercially, with landings of 45,910 metric tons in 1956, or 43.1 per cent of the catch of registered commercial fishing vessels of more than three tons gross. The aggregate investment in boats and gear is estimated by the Bureau of Fisheries at about 10 million pesos. The fishery has been for several years the cause of controversy between different fishing groups as to whether or not it causes depletion of the stocks.

It is stressed here that present research activities are to be recognized as only a start because the controversy demands the most detailed research. The trawl fishery exploits stocks of 98 species from 30 families of fishes. Not a single species is caught in abundance sufficient to sustain a distinct fishery.

The research, started in November, is being carried out mostly in Manila Bay. It was fully developed by January 1957, and provided an opportunity for a special training of counterparts, as all samples were collected aboard commercial fishing boats. The data obtained allow for a more detailed interpretation than those gathered in the research in pelagic fish species, which were mostly sampled from local fish markets.

Since no research vessel was available to catch samples in Manila Bay, the expert obtained the collaboration of

fishing boat operators, from November onwards, and 20 field trips of four to five days each were made. Two or three counterpart assistants participated in the study of the length-distribution of different species, catch composition, collection of fish samples for detailed study in the laboratories, locating catch positions, determining water temperatures and in collecting water samples for the determination of salinity in surface and bottom water layers at each haul station of the trawl net. The writer participated in the first operation aboard the fishing boat "Leonor" (13–16 November 1956), in order to train four counterpart assistants in taking fish samples, etc.

Research was extended to San Miguel Bay, in September 1957, three workers being sent out for a fortnight with all necessary equipment. They also carried out survey work on the benthos, plankton and hydrography. The operation was started to form a basis for a more comprehensive study of San Miguel Bay with regard to the otter trawl controversy, and to determine whether research in distant localities could be carried out from the central research station in Manila, or if the establishment of sub-stations would be necessary. Last, but not least, the work was started so that certain phenomena studied in Manila Bay could be interpreted.

3.31 *Slipmouth or sapsap* (*Leiognathus* sp.)

Leiognathus species are the most abundant of demersal fish in Manila Bay and in most of the other areas. In 1956, 16,590 metric tons were landed—15.5 per cent of the total catch.

From November 1956 to September 1957, 62 samples were taken aboard commercial fishing boats, and 88,410 specimens of ten species were determined and measured. Of these, 30,960 were examined in detail. Since April, 474 specimens have been examined for stomach content.

Taxonomic data were collected on 882 specimens of *Leiognathus splendens*, *L. daura*, *L. equulus*, *L. insidiator*, *L. leuciscus*, *L. bindus*, *L. ruconius* and *Gazza minuta* with regard to the numbers of gillrakers of the epi-, cerato- and hypobranchial of the gill arch; of finrays of the dorsal, pectoral, ventral, anal and caudal fins; of vertebrae; to

the total-, fork- and standard lengths, head length, body depth and eye diameter.

From January 1957 to June 1957 at Navotas, *Leiognathus* catches of fish corrals were investigated for comparison with the otter trawl catches. Twelve samples of 13,850 specimens were determined and measured; of these 3,700 were examined in detail (compare Chart of Monthly Progress of the Project, Pos. No. 25–34; Appendix 5.1).

The research staff consists of three biological workers, one taxonomic and one statistical.

3.32. *Threadfin bream or bisugo* (*Nemipterus* sp.)

The threadfin bream is the fifth in importance commercially. In 1956 landings were 3,810 metric tons or 3.6 per cent of the total catch, mainly caught by the trawl fishery.

As it is difficult to distinguish the 18 species recorded in Philippine waters, especially under working conditions aboard, the research initiated in November 1956 was concentrated only on *Nemipterus japonicus* which is easily recognizable. Taxonomic studies were not included in the programme owing to lack of staff.

Since November 1956, 78 samples of 16,470 specimens of *Nemipterus japonicus* have been determined and measured. Thirty-three samples of 8,840 specimens were collected, preserved and studied in detail in the laboratory. Since the start of investigations in April 1957 into the stomach content, 139 specimens have been checked. Two workers were assigned to biological and one to statistical work.

3.33 *Lizard fish or kalaso* (*Saurida* sp.)

The lizard fish catch of 4,580 metric tons, or 4.5 per cent is fourth in the landing statistics. The fish is caught mainly in the trawl fisheries. *Saurida* sp. is probably first in abundance in the trawl fisheries in the South China Sea, recently developed by fishermen from Hongkong, Formosa and Southern Japan. This research may become more important, if and when Philippine fishing boats participate in these fisheries.

Since November 1956, research has been conducted by a worker sent by Prof. F. Nemenzo, Head of the Department of Zoology, University of the Philippines, to write

his M. S. thesis under supervision of the expert. During 20 field trips, 93 samples of 20,040 specimens of *Saurida tumbil* and *S. gracilis* were determined and measured. Thirty-one samples were collected and preserved, and 23 samples of 4,950 specimens were checked in the usual way and with regard to stomach content. Taxonomic data were collected from 253 specimens, including counts of gillrakers, vertebrae and finrays of all fins.

3.34 *Shrimps*

Shrimps with 3,700 metric tons or 3.5 per cent come sixth in the commercial landings, but much higher in value, as they demand the highest price of any fishing product. Shrimps are caught mainly in the trawl fisheries.

The research initiated in November 1956 was limited in the beginning to questions of distribution in Manila Bay. In April 1957, another B. S. in Zoology graduate of the U. P. was assigned to check the preserved specimens collected during the commercial otter trawl operation.

Experiments were initiated to study the moulting behaviour in land tanks of 2 × 2 m. Unfortunately, the investigations, which are of importance in determining the growth rate, are hampered by lack of suitable research conditions. A physiological laboratory, equipped with aquaria and an air conditioner, is urgently needed.

Since November 1956, 110 samples of 20,320 specimens have been determined and measured during 20 field trips. Checking of the five samples preserved during the operation is underway, while 1,610 specimens have been studied in detail.

3.4 *Research on the distribution of some fish and crustacean species.*

3.41 *In the shallow coastal parts (2–15 m.) (baby trawl operation)*

This research was initiated with regard to the otter trawl controversy. Certain groups of fishermen, mainly owners of trap nets, sink nets, etc., accused the trawl fisheries of depleting some fishing grounds, and a bill was brought in to prohibit trawl fishing throughout Philippine waters. The Bureau of Fisheries proposed a

compromise, to prohibit trawl fishing in waters under ten fathoms in depth. At the request of the Director of Fisheries, the writer, in April 1957, initiated survey work on the distribution of fish species in the shallow coastal parts of Manila Bay in which trap nets, etc., are operated. This was to supplement the observations being made in the commercial otter trawl fishery, normally operated in waters of more than ten fathoms.

These researches are directed towards determining any overlapping of interests between different fisheries and to analyze the nature of those interests. This research also supplements that being carried out on the biology of demersal fish species.

With the co-operation of the Superintendent of the PIFT, Mr. Pidlaoan, the expert was allowed the use of a motor boat, which he equipped with a small otter trawl similar to that used in the "baby trawl" fishery. Two counterpart assistants, with two crew members of the J–boat, carried out 27 one-day's field trips, trawling systematically at five fixed stations along the western coast of Manila Bay between Cavite and the Pampanga River on the two-and five-fathom depth line.

Since September 1957 the operation has been carried out with the new motor banca at eight fathoms. A comparison of catches of certain species is therefore possible in the following depth steps: 2 fathoms, 5, 8, 10–15, 15–20 and 20–30 fathoms.

All catches of the baby trawl operation are preserved and analyzed in the laboratory and 68,950 specimens of 95 samples (net hauls) were determined and analyzed from April–September 1957. Two workers are assigned to the laboratory and one for the statistical work.

3.42 *In parts deeper than 15 m.*

The baby trawl operation and research on demersal fish species carried out in the commercial otter trawl operation are complementary. Since May 1957 research in the commercial otter trawl operation was extended to fish species found in abundance in the baby trawl catches, and 43 samples of 9,975 specimens of *Gerres, Therapon, Ambassis, Pentaprion, Apogon species* were measured.

3.5. *Oceanographic research*

3.51 *Hydrography*

Hydrographic observations were made in connection with the commercial otter and baby trawl operations. At each station water temperature readings and salinity samples were taken in surface and bottom water layers. Further hydrographic data were collected in connection with special research into the distribution of plankton (since April 1957) and of benthos (since August 1957). From 429 hydrographical stations, 795 temperature data were collected, 819 salinity, 166 oxygen, 76 pH, 154 phosphate and 154 transparency data.

Three workers were assigned to collecting and analyzing the data.

3.52 *Plankton*

In April 1957, after arrival of plankton nets from FAO, Rome, the investigations of the distribution of plankton were started, with special regard to the distribution of fish eggs and fish larvæ in and around Manila Bay.

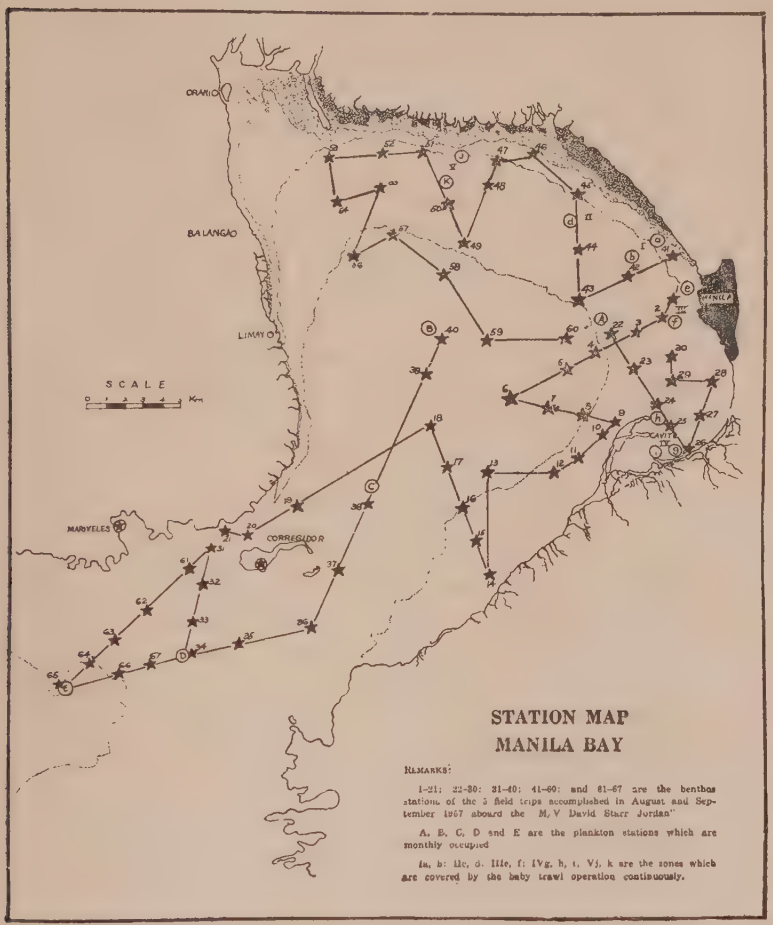
Each month, five stations in and outside the Manila Bay were visited by the "M/V David Starr Jordan" (see station map below). The visit to station E, far outside Manila Bay, was not possible in April and August due to bad weather.

Since April there have been seven field trips, the writer taking part in four. Twenty-nine stations were covered. At each station three vertical hauls with a Hensen egg net were made and, usually, one ten-minute horizontal drag with a ring trawl. In total, 97 vertical and 32 horizontal catches were carried out. Ninety-one of these were roughly sorted and determined. Lack of literature hinders the determination of species and, frequently, even genus and family. Research was occasionally extended to other sampling areas in July such as Batangas and San Miguel Bays. Interesting differences were revealed especially with regard to the quantity of plankton specimens From the eight samples collected in other areas, five have been checked.

Research established that the roundscad, which is mainly a zooplankton feeder, does not enter Manila Bay during certain months, when it is almost exclusively occupied by

phytoplankton. Food specimens were, however, abundant outside the Bay, which suggest that rich bag net fishing for roundscads could be established.

Two graduates of U. P. who are writing their M. S. thesis were assigned and trained in these researches.


ORANI
BALANGAO
LIMAY
MANILA
CAVITE
MARIVELES
CORREGIDOR
SCALE
Km
STATION MAP
MANILA BAY
REMARKS:
1-21; 22-30; 31-40; 41-60; and 61-67 are the benthos stations of the 3 field trips accomplished in August and September 1957 aboard the "M/V David Starr Jordan"
A, B, C, D and E are the plankton stations which are monthly occupied
a, b; IIc, d, IIIe, f; IVg, h, i, Vj, k are the zones which are covered by the baby trawl operation continuously.

3.53 *Benthos*

A benthos survey with a Petersen bottom grab received from FAO, Rome, was initiated in Manila Bay to determine

the animal life in and on the bottom. Research on the benthos biomass in tropical waters is rare and this programme will, therefore, fill an outstanding gap in the knowledge on the production biology of tropical waters. The correlation between the abundance of flatfish, which are considered as benthos feeders, and the quantity of biomass, will be studied. For instance, flatfish are much more abundant in San Miguel Bay than in Manila Bay, and research may reveal the reason. Researches will have also a certain importance with regard to the allegation that trawl fishing destroys bottom fauna.

Since August 1957, 67 different stations in and outside the Bay have been visited by the "M/V David Starr Jordan", and 99 bottom samples were taken and sieved. The sieve remains were preserved for laboratory examination. Eleven samples were roughly sorted. Fifteen stations will be visited to study the monthly differences.

Research was expanded to San Miguel Bay in September 1957. A graduate of U. P. who is writing his M. S. thesis, has been assigned to this work.

4. *Plans for future work and budget*

During the second year of assignment the expert will carry on the training through continuation of the research already initiated. Special attention will be given to the compilation of data, interpretation and, if possible, written reports. Responsibility with regard to the organization and programming of research will be given to the expert's counterpart assistant so that, at his departure, the work may be continued by the new staff.

To carry out the work the expert recommends very strongly that the proposed budget of the Bureau of Fisheries for fiscal year 1958–59 with regard to the final inclusion of items for positions of marine fisheries biological services within the Division of Fisheries Research be speedily accepted (see Appendix 5.2). It must be stressed that the prepared budget represents the minimum needs to guarantee the continuation of activities in marine fisheries biological research.

Appendices

5.1 Chart of Monthly Progress of the Project [a]

OUTLINE	Position No.
A. *Research on pelagic (surface) fish species*	1
1. Anchovy or dilis (*Stolephorus* sp.)	1
2. Roundscad or galongong (*Decapterus* sp.)	11
3. Chub Mackerel or hasa-hasa and alumahan (*Rastrelliger sp.*)	17
B. *Research on demersal (bottom) fish species and shrimps (commercial otter trawl operation*	25
1. Slipmouth or sapsap (*Leiognathus* sp.)	26
2. Threadfin bream or bisugo (*Nemipterus* sp.)	35
3. Lizard fish or kalaso (*Saurida* sp.)	42
4. Shrimps	48
C. *Research on the distribution of some fish and crustacean species in different parts of Manila Bay*	53
1. In the shallow coastal parts (2–10 m) (Baby trawl operation)	53
2. In parts deeper than 15 m	57
D. *Other oceanographic researches*	59
1. Oceanography	59
2. Plankton	66
3. Benthos	76

[a] Tuna researches are not included, because they have not been continued and were never really systematically performed due to lack of facilities. Taxonomic studies are also not included, because they are difficult to summarize in such a monthly survey. Inasmuch as the statistical work has also not entered this chart, it represents consequently only a part of the activities.

Chart of Monthly Progress of the Project

	1956		1957									Total	Pos. No.
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.		
A. *Research on Pelagic Fish Species*													
1. *Anchovy* (*Stolephorus* sp) (5–6 species under study)													
Number of samples (Manila Bay, Lucena)	8	9	13	15	31	18	19	24	13	8	14	172	1
Number of specimens determined and measured	2,000	4,000	5,800	2,900	9,900	6,100	3,900	8,100	9,200	6,200	7,520	65,620	2
from these following													
Number of specimens studied in detail [2]	1,100	1,800	2,300	2,400	5,200	3,200	2,100	4,360	3,590	2,980	4,330	33,340	
Number of stomachs sampled for food investigations	------	------	------	------	------	16	10	------	87	29	100	242	4
Number of specimens studied for stomach content	------	------	------	------	------	------	10	------	57	19	50	136	
Number of other sampling areas (such as Batangas Bay, Lingayen Gulf, San Miguel Bay, Iloilo)	------	------	------	------	------	1	------	1	3	3	3	------	6
from these following													
Number of new sampling areas	------	------	------	------	------	1	------	1	2	------	------	4	7
Number of samples determined and measured (each sample about 1–2 kg.)	------	------	------	------	------	1	------	3	6	6	▮	22	8
Number of specimens determined and measured	------	------	------	------	------	600	------	490	9,832	2,761	3,450	17,133	9
from these following													
Number of specimens studied in detail	------	------	------	------	------	30	------	340	990	800	1,200	3,360	10

2. *Roundscad* (*Decapterus* sp.) (2–3 species under study)													
Number of samples (Palawan waters and others)	1	1	3	3	4	4	5	5	4	6	7	43	11
Number of specimens determined and measured	300	600	1,100	2,200	10,200	4,700	3,520	2,620	3,510	1,800	1,980	32,530	12
from these following													
Number of specimens studied in detail	300	270	1,100	1,200	1,600	2,700	1,940	1,000	2,060	1,550	1,920	15,640	13
Number of fat analyses	10		20	16	23	32	18	30	24	18	45	236	14
Number of stomachs sampled for food investigations							34	91	62	60	140	387	15
Number of specimens studied for stomach content							34	91	36	10	50	221	16
3. *Chub Mackerel* (*Rastrelliger* sp) (2 species under study)													
Number of samples measured in the market										4	5	9	17
Number of specimens measured										620	1,180	1,800	18
Number of samples (different localities) preserved		2	5	11	10	16	7	9	13	7	11	91	19
Number of specimens preserved, determined and measured		150	400	1,000	800	600	450	400	400	300	490	4,990	20
from these following													
Number of specimens studied in detail		150	400	300	400				[3] 100	430	690	2,470	21
Pres. materials checked until the following month		XII	I	II	II				II	II–III	IV–VI	VI	22
Number of stomachs sampled for food investigations						15	enough material available					15	23
Number of specimens studied for stomach content						15						15	24
B. *Research on Demersal Fish Species and Shrimps*													
(*Commercial Otter Trawl Operation*)													
Number of field trips (each 3–5 days) on commercial fishing boats	2		2	2	2	2	2	2	2	2	2	20	25
1. *Slipmouth* (*Leiognathus* sp.) (10–12 species under study)													
Number of cans [4] of preserved specimen (otter trawl)	2		7	6½	5	8½	7	6	6	8	6	62	26

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Chart of Monthly Progress of the Project

	1956		1957									Total	Pos. No.
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.		
Number of specimens determined and measured	200	900	1,600	4,200	7,600	4,300	9,200	18,400	18,000	9,500	14,510	88,410	27
from these following													
Number of specimens studied in detail	200	900	1,600	3,400	4,200	2,000	4,500	2,000	3,300	4,000	4,860	30,960	28
Materials checked until following month	XI	XI	I	I-II	II	II-III	III-IV	IV	V-VI	VII-VIII	IX	IX	29
Number of stomachs sampled for food investigations						97	142	106	127	85	386	943	30
Number of specimens studied for stomach content						69	126	30	47	36	166	473	31
Number of samples (fish corrals)			2	2	2	4	1	1				12	32
							(bag net)	No fish corral season at Navotas during these months					
Number of specimens determined and measured			3,100	2,300	2,200	3,900	1,490	860				13,850	33
Number of specimen studied in detail			600	600	600	1,600	300					3,700	34
1. *Threadfin bream* (*Nemipterus japonicus*). (only 1 species under study)													
Number of samples determined and measured aboard	11			7	5	3	13	6	14	11	8	78	35
Number of specimens determined and measured aboard	1,880			2,000	1,500	670	2,580	1,840	2,860	1,690	1,450	16,470	36
Number of cans of pre served specimens	2		2	3	1	1	3	6	5½	5	4	32½	37
Number of specimens studied in detail		200	200		400	940	1,120	1,440	1,800	1,540	1,200	8,840	38
Materials checked until following month		XI	XI		I	II-III	III-V	V-VI	VI-VII	VII-VIII	IX	IX	39
Number of stomachs sampled for food investigations						19	11	20	50	9	30	139	40
Number of specimens studied for stomach content						19	11	20	50	9	30	139	41
3. *Lizard fish* (*Saurida* sp.) (2 species under study)													
Number of samples determined and measured aboard	9		8	9	7	8	11	5	15	11	10	93	42

Number of specimen determined and measured aboard	2,620		1,260	2,800	1,900	1,700	2,150	1,350	3,240	1,260	1,690	20,040	43
Number of cans preserved specimens	2		2	4½	2½	3	3	2	4	4½	3½	31	44
Number of specimens studied in detail	100	250	200	400	500	360	990	570	780	390	410	4,950	45
Pres. materials checked until following month	XI	XI	XI–I	I	I–II	II–III	III	IV	IV–V	V–VI	VI–VII	VII	46
Number of specimens studied for stomach content	100	250	200	400	500	360	990	570	780	390	410	4,950	47
4. *Shrimps* (3 species under study)													
Number of samples determined and measured aboard	12		14	4	2	9	13	12	18	12	14	110	48
Number of specimens determined and measured aboard	4,500		2,300	1,450	660	1,730	2,430	1,470	3,290	870	1,620	20,320	49
Number of cans of preserved specimens	2		1	2			3	1	3	1½	1	14½	50
Number of specimens studied in detail										1,210	400	1,610	51
Pres. materials checked until following month										VI	VII	VII	52
C. *Research on the Distribution of some Fish and Crustacean* sp. (*Manila Bay*)													
1. *In the shallow coastal parts* (2–10 m) (baby trawl operation)													
Number of field trips (each 8–10 hours)						5	3	3	5	5	6	27	53
Number of samples (net hauls) determined and measured in the laboratory						20	11	12	9	31	12	95	54
Number of specimens determined and measured						8,400	6,200	3,500	7,260	32,600	10,990	68,950	55
Pres. materials checked until following month						IV	IV–V	V–VI	VI–VII	VII–VIII	IX	IX	56
2. *In parts deeper than 15 m*													
Compare commercial otter trawl operation (B1–4) and to this.													
Number of samples of *Gerres* or *Therapon, Ambassis, Pentaprion, Apogon* specimens and others measured aboard							3	4	5	16	15	43	57
Number of specimens determined and measured aboard							680	1,360	2,535	2,380	3,020	9,975	58

Chart of Monthly Progress of the Project

	1956		1957									Total	Pos. No.
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.		
D. *Other Oceanographic Researches*													
1. *Oceanography (Manila Bay and surrounding arias only) (in connection with B, C and D2 and 3)*													
Number of stations (hauling of nets or fixed stations (D2, 3)[5]	30		28	29	15	47	35	37	47	102	59	429	59
Number of temperature data (surface and bottom)	60		56	58	30	94	70	74	94	184	75	795	60
Number of salinity data (surface and bottom)	60		56	58	30	94	70	74	94	184	99	819	61
Following data only in connection with D2 and 3													
Number of oxygen data							12	12	15	108	19	166	62
Number of pH data							10	11		42	13	76	63
Number of transparency data (Secchi disc)						3	5	5	5	60	7	85	64
Number of phosphate data								13	14	108	19	154	65
2. *Plankton (Manila Bay and surrounding areas only)*													
Number of field trips						1	1	1	1	2	1	7	66
Stations visited [5]						ABCD	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	29	67
Number of vertical catches (Hensens' egg net)						12	18	15	15	15	15	90	68
Number of vertical catches (small net, each 3 hauls)									2	3	2	7	69
Number of horizontal catches						5	5	5	5	7	5	32	70
Number of samples roughly sorted							17		43	22	9	91	71
Number of other sampling areas (such as Batangas Bay and San Miguel Bay)									2	1	1		72

from these following													
Number of *new* sampling areas									2			2	73
Number of stations and catches (vertically with small net, each catch represents 3 hauls)									5	1	2	8	74
Number of samples sorted										5		5	75
3. *Benthos (Manila Bay and surrounding areas).*													
Number of field trips										4	1	5	76
Stations visited [5]										60	15	75	77
Number of samples										60	33	99	78
Number of samples sorted											11	11	79

[2] Under "specimen studied in detail" is to be understood the determination of length, weight, sex, maturity stage, and very often also the determination of length and weight of gonads and the recording of number of parasites, if present. In the first months also scales and otoliths were collected.

[3] Whereas in the researches on Anchovies, *Decapterus* and *Leiognathus* caught in fish corrals, fresh samples are mostly studied and therefore the data concerning the number of specimens measured and studied in detail, belong to the same month as reported here and in most of the other species such is not the case. These 100 specimens were sampled in February. In the chart the work reported, has been done in the month under report. Due to lack of personnel, samples have been worked out sometimes several months later (compare my field reports).

[4] Each can contains about 20 liters sampling material.

[5] Position of fixed stations found in enclosed map.

5.2 BUDGET PROPOSAL FOR THE SECTION OF HYDROLOGY AND FISHERIES BIOLOGY FOR THE FISCAL YEAR 1958–1959

I. PERSONAL SERVICES		
A. Hydrology and Fisheries Biology Section		
1. 10 Assistant Fishery Technicians (Marine Biology) at ₱2,760 each (31)	₱27,600	
2. 13 Fishery Aides (Marine Biology) at ₱1,440 each (18)	18,720	
3. For hire of emergency laborers at ₱4.80/day	12,000	₱58,320
II. MAINTENANCE AND OTHER OPERATING EXPENSES		
A. Hydrology and Fisheries Biology Section		
1. Traveling Expenses including the IPFC Meeting	₱9,000	
2. Supplies and Materials	12,000	
3. Sundry Expenses	5,000	26,000
III. FURNITURE AND EQUIPMENT		
(Please see list hereto attached)		
A. Hydrology and Fisheries Biology		15,450
		₱99,770
IV. CAPITAL OUTLAY		
A. Hydrology and Fisheries Biology Section		
1. Completion of oceanographic building	₱2,000	
2. Requisition of 150 sq. m. land at Loñgos, Malabon, Rizal	700	
3. Construction of an air-conditioned physiological laboratory at Dagat-dagatan Salt-water Fishery Experimental Station	5,000	
4. Construction of boat shed, warehouse shed and pier at Dagat-dagatan Salt-water Fishery Experimental Station	6,000	
5. Making of a net loft and warehouse at Dagat-dagatan Salt-water Fishery Experimental Station	6,000	
6. Construction of a permanent foot bridge to Dagat-dagatan Salt-water Fishery Experimental Station	5,000	24,700
Grand Total		₱124,470

List of Equipment Urgently Needed by Section of Hydrology and Fisheries Biology

1. 1 Cable wire (5/16"), 2,000 meters	₱3,000
2. 1 Electric calculating machine	1,200

3.	1	Binocular stereoscopic microscope (less power)	₱1,000
4.	1	Binocular compound research microscope	1,200
5.	2	Camera lucida	300
6.	5	Reversing Nansen water bottles	1,250
7.	2	X-ray machines for fish specimen (Japanese make)	1,500
8.	3	Triple beam balance	250
9.	3	Slide rules	200
10.	1	Centrifuge	150
11.	1	Electronic flash	200
12.	3	Hensen eggnet	3,500
13.	3	Bottom eggnet	
14.	2	A Dredge	
15.	3	Plankton net, large	
16.	3	Fish larva net	
17.	2	Bottom grab Petersen, 1/10 cubic meter	1,000
18.	2	Steel cabinets	350
19.	2	Steel filing cabinets	350
		Total	₱15,450

5.3 LIST OF PERMANENT EMPLOYEES OF THE BUREAU OF FISHERIES PARTICIPATING IN THE TRAINING PROGRAMME

Mr. I. A. Ronquillo, M.A. Zoology, Stanford University, U.S.A., since October 1956.
Mrs. P. Borja, B.S. Zoology, U.P., since October 1956.
Mr. M. Llorca, B.S. Chemistry, Adamson University, since October 1956.
Mr. D. Gracia, B.S. Education, MLQ, since October 1956 (Temporarily).
Mr. B. Datingaling, B.S. Zoology, U.P., since October 1956.
Mrs. G. Caringal, B.S. Pharmacy, U.S.T., since October 1956.
Mr. H. Angeles, PIFT, Fish Culture, since October 1956.
Miss E. Fajardo, PIFT, Fish Culture, since October 1956.
Miss R. Mangahas, PIFT, Fish Culture, since October 1956.
Mr. V. Encina, PIFT, Fish Capture, since October 1956.
Mr. A. de Jesus, PIFT, Fish Capture, since October 1956.
Mr. D. Leoncio, PIFT, Fish Capture, since October 1956.
Mrs. R. Napugan, B.S. Chemistry, Adamson University, since October 1956.
Mrs. E. Caldito, PIFT, Fish Preservation, since October 1956.
Mr. E. Villamater, PIFT, Fish Culture, since October 1956.
Miss L. Mañalac, B.S. Zoology, U.P., since January 1957.
Miss E. Tan, B.S. Pharmacy, U.S.T., since January 1957.
Miss V. Batangantang, PIFT, Fish Preservation, since January 1957.
Miss C. Batangantang, PIFT, Fish Preservation, since January 1957.
Mr. J. Neri, PIFT, Fish Capture, since January 1957.
Miss E. Bobadilla, B.S. Zoology, U.S.T., since February 1957.
Mr. G. Legasto, student, since February 1957.

The emergency employees of the Bureau of Fisheries under training with the writer are:

Miss E. Royeca, B.S. Zoology, U.S.T., since October 1956.

Miss S. Ramos, PIFT, Fish Culture, since October 1956.
Mr. I. Ijiran, student, since October 1956.
Mr. A. Mines, B.S. Zoology, P.P., since November 1956.
Miss F. Arce, PIFT, Fish Culture, since December 1956.
Miss R. Necesito, PIFT, Fish Preservation, since December 1956.
Miss N. Fandialan, PIFT, Fish Preservation, since December 1956.
Miss A. Balalta, PIFT, Fish Preservation, since January 1956.
Miss C. Masajo, PIFT, Fish Culture, since February 1957.
Mr. A. Tengco, PIFT, Fish Culture, since February 1957.
Mr. B. Castillo, PIFT, Fish Culture, since February 1957.
Miss E. Parayno, B.S. Zoology, U.S.T., since March 1957.
Miss E. Simon, PIFT, Fish Culture, since March 1957.
Mrs. A. Damacion, B.S. Pharmacy, P.W.U., since March 1957.
Mr. A. Valdez, PIFT, Fish Capture, since March 1957.
Mr. S. Bravo, B.S. Zoology, U.P., since April 1957.
Mr. E. Bernabe, B.S. Zoology, U.P., since April 1957.
Miss P. Divino, B.S. Zoology, U.P., since April 1957.
Mr. V. Alvarez, PIFT, Fish Capture, since June 1957.
Miss L. Castro, B.S. Zoology, U.P., since June 1957.
Miss. T. Mangosing, B.S. Zoology, U.P., since July 1957.
Miss R. Calvelo, PIFT, Fish Culture, since July 1957.
Mr. J. Ordoñez, B.S. Zoology, U.P., since August 1957.

5.4 LIST OF TRAINEES AND ASSIGNMENTS

A. 1. *Anchovies:*

Mrs. Borja ..... (Statistics and Biology)
Miss Mangahas ..... (Biology)
Miss V. Batangantang ..... (Biology)
Mr. Legasto ..... (Biology)
Miss Mañalac ..... (Taxonomy)
Miss Balalta ..... (Taxonomy)
Miss Tan ..... (Statistics)
Miss Simon ..... (Statistics)

2. *Roundscads:*

Miss Royeca ..... (Biology)
Miss Parayno ..... (Biology)
Mrs. Damacion ..... (Biology)
Mr. Angeles ..... (Taxonomy)
Mr. Villamater ..... (Taxonomy)
Mr. Ijiran ..... (Statistics)
Mrs. Napugan ..... (Fat analyses)
Mrs. Caldito ..... (Fat analyses)

3. *Chub Mackerels:*

Miss Fajardo ..... (Biology)
Mr. Tengco ..... (Biology)
Miss C. Bantangantang ..... (Taxonomy)

Food Investigations in connection with A1–3:
Miss Castro ..... (Thesis for M.S. in Zoology

B. 1. *Slipmouth:*

Miss Arce ..... (Biology)
Miss Necessito ..... (Biology)
Miss Bobadilla ..... (Biology)
Mr. Castillo ..... (Taxonomy)
Miss Ramos ..... (Statistics)

B. 2. *Threadfin Bream:*

Miss Masajo ..... (Biology)
Miss Fandialan ..... (Biology)
Mr. Datingaling ..... (Statistics)

3. *Lizard Fish:*

Mr. Mines ..... (Biology, Taxonomy and Statistics) (Thesis for M.S. in Zoology)
Mr. Alvarez ..... (Biology)

4. *Shrimps:*

Mr. Bravo ..... (Biology, Taxonomy and Statistics) (Thesis for M.S. in Zoology)

Food Investigations in conn. with B1–2:

Miss Divino ..... (Thesis for M.S. in Zoology)

C. *Baby Trawl Operation:*

Mr. de Jesus ..... (Sampling)
Mr. Valdez ..... (Sampling)
Mr. Neri ..... (Catch analyses)
Miss Calvelo ..... (Catch analyses)
Mr. Gracia ..... (Catch analyses)
Mrs. Cariñgal ..... (Statistics)

D. 1 *Oceanography:*

Mr. Llorca
Mr. Encina
Mr. Leoncio

2. *Plankton:*

Mr. Bernabe ..... (Thesis for M.S. in Zoology)
Miss Mangosing ..... (Thesis for M.S. in Zoology)

3. *Benthos:*

Mr. Ordoñez ..... (Thesis for M.S. in Zoology)

The following workers were responsible for the performance of the sampling programme at sea and developed into excellent sea-going men: Mr. Encina, Mr. Mines, Mr. Alvarez, Mr. Angeles, Mr. Valdez, Mr. Castillo, Mr. Bravo, Mr. Ordoñez—in the commercial otter trawl operation aboard commercial fishing boats; these and Mr. Llorca, Mr. Datingaling, Mr. Gracia, Mr. Legasto, Mr. Bernabe, Mr. Leoncio, Mr. Ijiran, Mr. de Jesus and Mr. Tengco.

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